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# FACTORS RELATED TO VOCATIONAL INTERESTS*

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## I. Introduction

Theories of interests have come down from the times of Plato, Rousseau, and Herbart, and more recently, from James, Spranger, Dewey, Burnham, Thorndike and Hall. When psychologists have become concerned with the affective aspects of activity, they have approached the problem with the concept of interests.

As in so many other fields, scientific activity in this field is accompanied by disagreement concerning definitions and terminology and by lucanae of knowledge essential for the completion of a theory of interests. The lucanae can be filled only by much investigation and study; the definitional and terminological problems solved only by discussion and agreement.

Definitions of interests have varied according to the systematic biases of the authors. As Fryer (23) says:

> The structural psychologist defined interest as feeling, an element of experience, or if not as a mental element, as a complex thought experience with a strong feeling component . . . . The functional psychologist brought in the dynamic factor and defined interest as a moving, habitual experience with ideas of future reference and with a strong feeling component.

William James (31) used attention as the main criterion of interest and this is still the definition of interests found in Warren's Dictionary of Psychology. In 1913 John Dewey (15) defined interests as "the accompaniment of the identification, through action, of the self with some object or idea, because of the necessity, of that object or idea for the maintenance of a self-initiated activity."

Another version of this definition, perhaps simpler, is given by Threlkeld (59).

* This review was written before the appearance of the comprehensive and masterly volume by Strong (Strong, E. K., Jr. Vocational Interests of Men and Women. Stanford Univ., Cal., Stanford Press, 1943.) The author regrets that his Service obligations make impossible the inclusion of material from or comment upon that book and urges readers who are concerned with vocational interests to become familiar with its contents.

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Interest is not some one thing; it is a name for the fact that a course of action, an occupation, or a pursuit absorbs the powers of an individual in a thoroughgoing way. But an activity cannot go on in a void. It requires materials, subject matter, conditions upon which to operate. On the other hand, it requires certain tendencies, habits, powers on the part of the self. Wherever there is a genuine interest, there is an identification of these two things.

The definition of interests which has obtained most agreement is that given by Fryer (23). Approaching the studies of interests while remembering this definition will perhaps assist in the reconciliation of divergent interpretations.

During the last ten years—interests have come to be regarded as complex configurations of feeling experience . . . . The criterion of interest is thought of as the feeling.

Interest stimuli are things which stimulate an individual to react with feeling. When there is a feeling aspect in the experience brought about by their stimulation the experience is an interest experience. The stimulus causing a pleasant experience is an interest. The stimulus causing an unpleasant experience is an aversion . . . . Subjective interests and aversions, then, are defined in terms of objects and activities stimulating the individual to have feeling experiences, and this experience can be estimated by the person being stimulated as to its qualities of pleasantness and unpleasantness, and as to the intensity or degree of feeling.

Almost inevitably, psychologists attempting to understand and predict human behavior must be concerned with the problem of interests. Abilities and interests are the co-determiners of achievement, whether it be vocational, educational or athletic. Predictions of performance in true-to-life situations based on indices of ability alone have been found inadequate. The use of interests in making these predictions offers much promise. Studies in interests are actually studies in motivation. The psychology of needs, goals, motivation, and interests presents a composite picture involving the entire affective aspect of behavior. The understanding of behavior requires a more complete knowledge regarding these problems. When the determinants of interests are more completely understood, the psychologist will have obtained keys to many of the hither-to unsolved riddles of personality. The educator, the psychiatrist, and the vocational counselor will then be able to incorporate this knowledge into their work and presumably operate on a more efficient level.

This review of the literature will attempt to summarize the information now available concerning the determinants of vocational interests and more important, to indicate gaps in this information. Many questions concerning vocational interests have been answered inadequately and many others have not been answered at all. The most recent* summary of the literature is found in Fryer's book, *The Measurement of*

* See footnote on preceding page re Strong's new book.

*Interests* (23) published in 1931. Much work has been done since that time and many of the studies reviewed in that book have assumed new implications in light of recent investigations and developments.

The following sub-sections have been arranged according to whether the determinants considered are *relatively* intrinsic—age, sex, and ability—or whether they inhere in the individual's social framework or context—family, school and teachers, work experience, occupational information, hobbies and activities. None of these factors can be assigned wholly to the individual or to his social setting, yet the above classification will perhaps clarify the discussion.

## II. Determinants Intrinsic in the Individual

### *Sex and Vocational Interests*

The studies reported by Terman and Miles (58), Strong (55), and Mead (36) give systematic substantiation to the laymen's observation that the interests of men and women do differ. This difference occurs when we consider vocational interests. The masculinity-femininity key of the Strong Vocational Interest Blank is based upon this sex difference. Occupational groups form themselves into a hierarchy of masculinity-femininity upon the basis of their measured interests.

The vocational choices of boys and girls are also characteristic of their sex. An unpublished study by Darley reveals the extent of this sex difference. In 1941, of 7791 boys graduating from Minnesota high schools, 17% had chosen engineering as their future occupation. Of the 10,603 girls, only .1% had chosen engineering. Of the boys, 4% planned on being teachers; of the girls, 19% chose teaching. Of the boys, .8% were planning on doing routine clerical work, of the girls, 3% were planning on doing this work. The general trend of the results would certainly be predicted by anyone familiar with our society. The explanations of these sex differences are less obvious.

A case study reported in detail by C. C. Miles (37) shows that a male pseudohermaphrodite reared as a female for over seventeen years maintained masculine interests as measured by the Terman-Miles M-F test and the Strong Test. On the Strong Test his masculinity-femininity percentile score was 61. On the M-F test he obtained thoroughly masculine total scores. Although there is little doubt that interests are influenced to some extent by social pressures, this single case suggests that sex differences independent of social pressures influence the interests characteristic of either sex (37).

The anthropological studies by Mead (36) place great stress upon the cultural mileau, but the temperamental differences she has described are not the same as the interest differences discussed here. An hypotheis bearing further investigation is that sex differences in interests are related to physiological or physical variables. In line with this

a unique study by Sollenberger (51) on maturing boys has been reported. His groups were too small, 10 and 23, to permit his results to be conclusive, but the study is very suggestive. In using Furfey's Test of Developmental Age, Lehman's Play Quiz, and Pressey's Interest Attitude Test, he found some significant differences between boys with high male hormone content in the urine and boys with low male hormone content, holding age constant. The high content group was rated as behaving more maturely and received significantly different scores on the Furfey test. They were more interested in heterosexual activities, personal adornment, and strenuous competitive sports.

To what extent physiological differences such as this determine sex differences in interests, we as yet do not know. Neither do we know how physical structure and physiological variability are related to vocational interests. Are different somatypes characteristic of people having different vocational interests and do factors such as visual acuity, basal metabolism, and muscular strength influence the development of an individual's vocational interests?

### *Age and Vocational Interests*

The influence of age upon vocational interests has been most thoroughly investigated by Strong (54) and the interest maturity scale of the Strong Vocational Interest Blank is based on the age differentials here present. As successively older groups of men were studied, their interests tended to become more esthetic, more cultural, less athletic, and more feminine.

Carter has studied the vocational interests, as defined by the Strong test, of high school boys and girls and has concluded that the Strong test is a useful measuring instrument with people in this age group (8). Measured vocational interests apparently reach a point of relative stability soon after physical and intellectual maturity. The changes that occur with increasing age are relatively slow and systematic. Perhaps, Strong has suggested, as men grow older, they become domesticated, and the changes in measured interests reflect this process.

Vocational choices of students also tend to become more realistic as the age of actual occupational embarkation is approached. As students start seriously to consider training requirements and limitations of ability, the vocational choices shift from the glamorous to the practical. Systematic longitudinal or comparative cross sectional studies to bear out this impression, however, are absent.

### *Ability and Vocational Interests*

The conclusion reached by Fryer (23) in 1931 still is valid.

> Specialized interests have little relation to specialized abilities, either in the field of occupations or the field of education . . . . The relation between inven-

toried interests and intelligence is negligible . . . the relation between mechanical interests and mechanical abilities appears also negligible.

Early studies, including those of Thorndike, showed a high relationship between interests and *estimated* abilities. These findings have not been verified with *tests* of abilities.

Strong (56) reports correlations ranging from +.38 to −.33 between 35 keys of the Strong Interest Blank and the Thorndike Intelligence Examination for High School graduates. Darley (12) reported correlation ratios from .04 to .31 with six representative keys of the Strong Interest Blank and the factor scores of the Tests of Seven Primary Mental Abilities. The median value of these 42 correlations was .09. In his twin study, Carter (7) reported a mean correlation of .10 between 23 keys of the Strong test and IQ. These correlations ranged from −.44 to .36. These studies using correlational methods to investigate the relationship between interests as measured by the Strong blank and verbal intelligence have consistently suggested that if abilities do influence measured interests, this influence apparently is not very great.

A study by Berdie (4) compared a group of 42 men having interest in engineering, as measured by the Strong test, with a group of 94 men not having measured interests in engineering. The scores of the engineering group on the American Council Examination were significantly higher than the scores of the other group but this difference was significant only at the 5% probability level. Comparisons of other interest groups revealed no other significant differences. Studies based on group comparisons will most likely substantiate the correlational studies.

Results based on other measures of interests and abilities are generally in agreement. Reed (43), using the Thurstone Vocational Interest blank and the Henmon-Nelson Intelligence test found low correlations which were not statistically significant. Garretson (24) and King (32) using other tests obtained the same results.

Some relationship is almost inevitable between ability and expressed vocational interests, although Hutson suggests this relationship is smaller than might be suspected. In a study (30) on approximately 2700 students in grades 7 to 12, he found,

> The median IQ of the boys who would enter the professions is but seven points higher than that of the boys who have chosen careers in the skilled trades . . . . Twenty-five per cent of the 417 boys who elect to enter the professions have IQ's below 98.4 while 25 per cent of the 411 electing the skilled trades have IQ's above 109.5. The girls' choices showed a similar distribution. Comparison of the interquartile range of IQ's of the boys with the figures adopted from the Army Alpha results, shows that among the workers in professions and in skilled trades there is no overlapping between the middle fifty per cent. The same groups of boys overlap by two-thirds.

When people make an occupational choice, they are usually forced

to make an estimate of their own abilities. Hirsch (28) found a higher relation between estimated ability and expressed interests (what the child liked best) than between tested ability, as measured by various forms of the Binet, and expressed interests. The correlation between actual ability and interest was .20, between estimated ability and interest, .48. The statistical significance of this difference can not be validly determined, but in light of the size of the sample of 600, Hirsch's conclusions appear justified.

Although much evidence regarding the relationship between general abilities and interests suggests little association, little evidence is available concerning the relationship between special abilities and interests. Does the person with unusual ability in music, art, mathematics, speaking or writing have interests characteristic of those abilities? Endicott (20) found that 13 per cent of the 317 boys he studied checked that their vocational choice had been influenced by special ability. The keys on the Strong Interest test for musicians and artists suggest that the people in the standardization group who had sufficient ability to become successful in these vocations had characteristic measured vocational interests. This does not necessarily imply a general relationship.

Many questions remain to be answered concerning the relationship between abilities and interests. The available evidence indicates, however, that a person's ability is not a very important factor in determining his interests, and although a relationship can be found between the two factors, this relationship is so small that we must look further if we are to understand the sources of vocational interests.

## III. Social Correlates of Vocational Interests

Sex, age, and ability are conditions not susceptible to social controls. Any influence these factors have upon vocational interests is relatively constant. Other factors related to vocational interests are not so fixed and exert their influence in a more socially controllable way. Familial influences, schools and teachers, etc., are all factors which are not intrinsic in the individual but rather components in his social framework. Like other aspects of personality, vocational interests are determined to an as yet unknown extent by these factors.

### *Family Influences and Vocational Interests*

The family is the social group with which the individual has most direct contact. If familial influences determine personality, they are also likely to be determinants of vocational interests.

A recent study by Hirschberg and Gilliland (29) is representative of many studies upon familial similarity of attitudes. Correlations ranging between .25 and .66 were found between scores of parents and children on the Thurstone Attitude Toward God Scale, Stagner's Opinion about

the Depression Scale, and Loma's Attitude Toward the New Deal Scale. A more comprehensive study by Remmers and Whisler (**44**) reports average correlations of .69 and .55 between attitudes of mothers and children and fathers and children, respectively. The scale used here was Remmer's Scale to Measure Attitudes Toward any Institution or Race and covered attitudes toward movies, sex education, schools, capital punishment, and divorce. This demonstrated similarity of attitudes may be due to exposure to mutual influences or due to a conditioning effect exerted by the parent's attitudes upon the attitudes of the children. Family resemblances of vocational interests may be similarly explained.

Many investigators have emphasized the influence of the family upon vocational choice (**20, 25, 34, 38, 41, 46, 60, 61**). All of these authors state that the vocation of the parents, the wishes of the parents, or both have profound effects upon the vocational choices of students. Peters (**41**) states the family is the greatest single agency in determining vocational choice. The people in his study, as well as the people in the studies of Valentine and Ritchie (**61**) were asked to check the reasons lying behind their vocational choices. The results of these studies do not indicate reasons underlying vocational choices but rather reasons given by students as underlying their vocational choices.

A few investigators, however, have concluded that family factors are relatively unimportant in influencing vocational choices. Crouch (**10**) in studying the factors influencing the vocational choices of 33 problem boys and girls of adolescent age, concludes "although intellectual capacity, the occupation of the father, and the suggestion of their parents and friends played a role of some importance in the students' choice of vocations, unfavorable emotional influences and the stress of the adolescent period seemed to furnish more adequate explanations as to why they chose as they did." This study consisted of a clinical evaluation of complete case records and no statistical evidence is presented.

Anderson (1) conducted a study of 673 college men. Of 668 cases, 12% chose the occupation of their father, chiefly farming. Forty per cent had fathers who had made vocational suggestions and thirty-five per cent had mothers who had made vocational suggestions. Of the 267 cases whose fathers made suggestions, 27% accepted the father's suggestion in regard to vocations. Only about 1 student in 10, however, believed himself influenced by parental suggestion. These results are in close agreement with those of a similar study conducted by Bedford (**3**).

In a study of 550 boys and 537 girls, 8–17 years of age, Sheldon (**50**) found the occupation of the father had little influence upon the occupational choices of children. Nelson (**38**), in a study of 321 students of both sexes from 18 colleges, found a significant positive but low relationship between the occupational choice of the student and the vocation of the

father. Monroe, in a study cited by Fryer (23), "studied the interests of 157 children up to 14 years in age. The majority of the fathers were laborers, yet only one wished to follow his father's occupation and over 50% wished to enter the professions."

These results appear to be in contradiction to another study cited by Fryer (23).

> Barnes . . . secured records of vocational ambitions from 2360 London Board School Children (1000 boys; 1360 girls), ages 8 to 13 years . . . . The children studied by Barnes were from the laboring and artisan classes. There would necessarily be, it would seem, some adjustment of the interests in this list to the practical opportunities. Thus, there are 55 per cent of the boys expressing their vocational interests in the occupations of artisan or laborer . . . . The averages show that there is about 50% realization of the children's (girls) vocational interests.

The above paragraphs suggest that all is not in perfect accord regarding the importance of the family upon vocational choices. Some investigators have claimed parental occupations, wishes and advice are important factors in influencing vocational choices. Others have claimed they are relatively unimportant.

Several reasons serve to explain these discrepant conclusions. Endicott (20) has discovered the existence of sex differences, girls being more influenced by parents. Kroger (34) in his study of 4543 high school boys, has discovered that parental influences vary with the father's occupation. "Sons of fathers in the higher occupations tend more frequently to be influenced by their fathers' occupations than boys whose fathers' occupations lie lower in the scale." We have already noticed how results may depend upon the method of determining reasons underlying vocational choices. Students, asked for reasons, as in Valentine's study, may give different reasons than those discovered through a clinical analysis, as was done in Crouch's study.

Results are also dependent upon the job classification used. Using broad classifications, as has been done in studies of occupational mobility (2, 6, 14, 47), the influence of the family upon vocational choices will perhaps appear greater than if specific jobs are considered. These studies of occupational transmission also show that the relationship between familial occupation and actual occupation is greater than between familial occupation and expressed vocational choice. We must be careful in distinguishing between vocational aspiration and actual vocation in such studies. This means the time factor is important. The closer the time of determining vocational choice to actual introduction into the occupation, the greater the influence of parental occupation will appear.

One additional explanation must be made concerning the discrepant results cited. Vocational choices are determined by many influences.

Often neither the student nor the investigator can determine how these influences should be classified or what importance should be attached to the various influences present in a given case. Thus (60), "A boy wrote that he wanted to be an engineer, but his father wanted him to take a clerkship, so, 'as it was the only job available, I took his advice'!"

The wisdom or appropriateness of vocational choices made under family influences has been questioned by some authors. Dyer (19) writes, "It is likely that decisions made in line with the family tradition and the counsel of relatives, teachers and friends should be subjected to unusually close scrutiny." He found that relatively few of 101 college men influenced by these factors remained in their chosen occupations for five years. Cunliffe (11) in a study of 535 students, found that the students with the least occupational information were those whose occupational choice had been influenced by advice of parents or family.

All of the above studies have concerned the effect of the family upon expressed vocational interests. Only a small number of studies are available on the effect of the family upon measured vocational interests. A study by Carter (7), using 120 pairs of twins, has demonstrated definite relationships between the interest patterns of twins. The average correlation for identical twins was +.50, for fraternal twins, +.28. Corrected for unreliability of the scales, these would be considerably higher. The correlation between intelligence and interests is not high enough to account for these correlations. Using the statistically more secure average of transformed "Z" does not significantly alter the results found by averaging the correlations. This suggests that familial similarity of interests is comparable to that found for other psychological data, particularly personality measurements.

Forster (22) gave the Strong Interest Blank to 125 pairs of male college students and their fathers. The coefficient of correlation between fathers and sons on 25 occupational scales ranged from .00 to +.48 with an average coefficient of +.33. Rank difference correlations between the occupational scores of the individual father and son pairs range from −.42 to +.95 with a median at +.66. The same coefficients for unrelated pairs ranged from −.56 to +.93 with a median at +.36. As a by-product of a study on another problem, Dvorak (17) found a relationship to exist between the measured interests of physicians and their sons. Berdie (4) found that high school graduates whose fathers were in the skilled trades tended to have measured interests, as shown by the Strong test, in scientific and technical fields and students whose fathers were in business tended to have measured interests in business. Apparently measured vocational interests are influenced by familial factors.

Parental occupations, desires and advice are not the only familial factors which might possibly influence interests, although they are the only ones which have been investigated. Some investigators have found

relationships between other familial variables and measured personality traits. Although the results of several studies are not in agreement, they do suggest the possibility of other sources of interests. In a study of 802 children, using a test of moral knowledge, Maller (35) concluded "the size of the family correlates negatively with intelligence, moral knowledge ($r = -.23$), cultural background and with honest behavior." These relationships did not appear to be linear.

Hayes (27), in a study of 76 women college students, using the Bernreuter test, concluded " . . . family position may be associated with quite significant differences in personality. The more older siblings a subject had, as long as she had at least one, the more neurotic, the less self-sufficient and the less dominant she was likely to be."

On the other hand, in a study of 430 University men, Stagner and Katzoff (52), using the Bernreuter test, conclude, "The effect of family constellation should be considered as only a small portion of the continuous interaction which determines personality." Wiles and Noetzel (62) concluded, "Our studies suggest that ordinal position is not an especially significant factor in fixing a personality type or in establishing definite forms of difficulty in adjustment or in determining dominant attitudes and responses in human relations." Stuart (57) also found no consistent relationship between family constellation and personality adjustment as measured by the Colgate Mental Hygiene Test.

These apparently discrepant results may also be due to a variety of factors. Sex differences may exist. Tests of varying validity may give different results. Methods of expressing family constellations may determine results. Various aspects of personality may be influenced differentially by these factors. Any discussion of conditions associated with vocational interests should therefore take into consideration familial factors other than parental occupation, advice and desires.

One factor that should be considered is that of family occupation. Children raised in a home dominated by a certain occupation are likely to be influenced by that occupation. A boy whose father, grandfathers, uncles and brothers are physicians will perhaps have different vocational interests from a boy raised on a farm by a farmer father and a farmer grandfather and having farmer uncles and brothers.

Studies of occupational mobility (14) have demonstrated a tendency for families to remain on the same occupational level through three generations. Scattered descriptions of family pedigrees (33) have indicated a similar tendency for specific jobs to run in families. Family tradition is one important factor in determining the vocational interests of some people.

Parental education is perhaps another factor influencing vocational interests. The cultural level of the home is determined for the most part by the level of the parents' education. A child surrounded by fine paint-

ings, good books, high-brow magazines, and intelligent discussions can be expected to develop different vocational interests from a child not exposed to these things. The family income may be similarly associated with vocational interests. The occupational level key of the Strong Interest Blank suggests these family factors are worthy of investigation.

The family undoubtedly has a profound effect upon the evaluative aspects of the child's development. His desires, his satisfactions, his dissastisfactions, his sense of values are all influenced by the family. The type of person he admires is often expressed by his vocational choice. The type of thing he desires is often the goal of his vocational plan. For these reasons the part the family plays in the students' affective life should be studied in an investigation of conditions influencing vocational interests. Family adjustment and family dependency may be important factors in determining these interests.

### *School and Vocational Interests*

Students consider their vocational choices to be influenced by studies they take in school and by their teachers. One of the most stereotyped responses obtained in a school counseling program is in answer to the question why a boy desires to become an engineer. The response almost invariably is that the boy liked chemistry and got along well in mathematics.

Valentine and Ritchie (61) found that 32% of an unreported number of individuals gave as their reason for choosing a vocation the influence of a favorite school subject. In a similar study, Pinney (42) found that 128 students claimed school activities had influenced their vocational choice while 315 said they had not. Peters (41) found that 10% of his students checked their vocational choices had been influenced by teachers. Endicott (20) also found that 10% of his students checked that their teachers had been one of the two most important influences upon their vocational choices. Dyer (19) cautioned that the influences of teachers might not be altogether favorable.

The old question again arises. Does a pleasant experience in school influence the student in making a vocational choice or do both the pleasant experience and the vocational choice result from a personality which is particularly responsive to a related class of experiences. Possibly the pleasant, or unpleasant experiences serve to reinforce a preference or a disliking for a certain kind of work.

Many factors determine a student's liking for a course in school. Shakespeare (49) studied 4572 boys and 4555 girls, 10–14 years old, who ranked the courses in order of preference and gave the reasons for their liking.

> Generally the subjects which permit bodily activity on the part of the pupil are the more popular. There is a period in the life of the pupil, about eleven plus,

when there seems some devotion to subjects where perceptible results may be obtained, when achievement in a subject has a great influence upon its popularity. Later the development of an interest extraneous to school brings a utilitarian idea which seems to influence popularity.

These same factors might influence vocational interests in a similar sequence.

Workers in secondary schools have attempted to influence the occupational interests of students by presenting them with occupational information through lectures, films, tours, and various other projects. Only recently has any evaluation of these attempts been made.

Remmers and Whisler (45) did a comprehensive study of the effects of a guidance program on students' vocational attitudes as measured by the Miller-Remmer's Scale for Measuring Attitudes Toward any Vocation. They studied the attitudes of two hundred and twenty-five 9–12 graders toward electrical engineering, aviation, farming, teaching, secretarial work, etc. They gave form A of the test, then introduced a guidance program of talks, case studies, dramatized interviews, and self-guidance tests. They then gave form B of the test. Scores were more favorable toward farming and less favorable toward secretarial work on the retest. The variability was greater after the program. The authors attribute this to greater heterogeneity caused by the given information breaking down stereotypes. Final attitudes were interpreted as being more realistic. Correlations of Form A and B ranged from .34 to .72, being low and positive. No control groups were used.

A study has been published by Stone (53) showing the influence of a series of courses in occupations upon the vocational choices of students. There were 118 college students in his experimental group who had various combinations of occupational courses and clinical counseling and 140 students in his control group. He found that although counseling alone or occupation courses alone did not greatly improve the appropriateness of students' vocational choices, the choices were more appropriate for those students who had been both counseled and in the occuaptions courses. Apparently occupational information obtained in the courses was effective in improving the students' vocational choices, although giving occupational information with no counseling was not.

Cunliffe (11) found that the best informed students were those who had studied occupations in school. Of 1211 students studied by Bedford (3), 58% said they knew the training required for their chosen occupation. Of the students in the schools offering vocational guidance, however, 73% said they knew what these requirements were.

Crapullo (9) studied the choices of 94 high school students in rural and city high schools in New York. Of these students, 22, or 23% did not know what duties were performed in the active practice of their

chosen vocation. Not one student reported the study of occupations had influenced his choice of vocation. Pinney (42) found that 383 students professed knowledge of the required training for their chosen vocations while 60 said they did not know what this training was.

There appears to be but little relation between the occupational choice of a student and the occupational information at his command. This might be a function of the method of teaching vocational information. Occupational information considered independently from the interests and abilities of students may not influence their choices, whereas information presented in such a manner as to allow students to relate it to themselves may help them in wisely choosing a vocation.

No information is available concerning the occupational information possessed by an individual and his measured vocational interests. A theory propounded by Bordin (5) suggests a person's interest profile is in part a function of his idea of the occupations he has considered. If this is correct, the interest profile can be altered by giving occupational information. This hypothesis is now being tested. Regardless of this theory, many people obviously have measured interests similar to the interests of workers in a field of which they have never heard.

### *Vocational Interests and Work Experience*

Students occasionally ascribe the source of their vocational interests to work experience they have acquired after school or during summer vacations. Pleasant or unpleasant experiences while doing a certain type of work influence a student's emotional response to that work and he may decide to attempt to continue in it or to leave it. Some girls will not consider teaching as a vocation because of difficulty they have encountered while teaching young children in Sunday School. Some boys will not consider business as a vocation because they found saleswork in a grocery store on Saturdays either too strenuous or too monotonous. Other boys wish to enter business because they particularly enjoyed a job they had in that field. Little specific information is available concerning the relation between vocational interests and work experience.

Students having the most vocational information were those who had made their vocational choices upon the basis of work experience and study of that occupation, according to a study by Cunliffe (11). It is probable they were also the people with the most appropriate vocational choice. In a study of 1211 high school students, Bedford (3) found that of the 88% who had chosen an occupation, 513 had previous vocational training or experience. Of these, 46.4% had chosen an occupation related to this training or experience. Of those who had chosen an occupation, 12% gave as a reason for this choice previous experience in that work. Pinney (42) in a study of 916 high school students, found that 74

students claimed their vocational choice had been influenced by summer employment and 369 said it had not been so influenced. The other students did not respond to this item of the questionnaire.

These studies suggest that work experience has some influence upon the vocational choices of students and also upon what they consider the reasons for those choices. There is no information, however, to suggest whether work experience influences measured interests or not. If measured interests are expressions of basic personality structures, it is not likely that relatively superficial work experiences would influence them. Some work experiences, on the other hand, can perhaps have profound effects upon personality, and might therefore be associated with measured interests. Work experience implies the student is obtaining information regarding job duties and requirements and becoming acquainted with working conditions and his reactions to these conditions. This constellation of experiences might be one of the determinants of measured vocational interests.

### *Hobbies and Activities and Vocational Interests*

A student is usually able to exercise more selection in choosing a hobby or avocation than in choosing his work experience. For this reason we might suspect hobbies would bear a closer relationship to vocational interests than would work experience.

In a study of 380 high school seniors, Peters (41), using a check list, found that 4.7% checked their vocational choice had been influenced by hobbies. Compared to the influence of parents and relatives, teachers, friends, acquaintances and opportunity for study and employment, the reported influence of hobbies was not very great. Dyer (19) interviewed 101 college men and determined their occupational status 5 years later. He had originally determined the source of their vocational choice. He found that of those placing the sources of their choices in the following categories, the indicated per cent remained in the occupation for five years.

| | |
|---|---|
| Boyhood hobby | 90% |
| Boyhood occupation | 86% |
| Family situation | 84% |
| Classroom inspiration | 75% |
| Counsel of friends | 67% |
| Origin not clear | 60% |
| Total | 78% |

Dyer concluded, "Hobbies and boyhood occupations are vital instruments of vocational selection." A ten year follow-up study of these people revealed the same trends (18).

As with work experience, few investigations have been reported on

the relation between hobbies and measured interests. Many items on interest tests refer to hobbies and activities, so we can suspect that hobbies and activities do bear a close relationship to the results of those tests.

## IV. Personality and Vocational Interests

Factor analyses have uncovered constellations of behavior which, considered in their entirety, constitute personality. Vocational interests are distinct but integral aspects of this personality structure. Studies of measured vocational interests have shown them to be associated with other personality dimensions in a systematic fashion. Commonly accepted occupational stereotypes suggest that expressed vocational choices are also associated with these personality dimensions.

Up to this point in the discussion of factors related to interests, most of the studies have concerned expressed vocational interests, or occupational choices. Relatively few of the studies have considered measured vocational interests. Studies concerning interests and other personality characteristics however have dealt mainly with measured interests and but little information is available regarding the relationship between vocational choices and other personality characteristics.

One study by Nelson and Nelson (**40**) has reported the relationship between the vocational choices of 3752 students and their scores on the Lentz Opinionaire on Radicalism, the Thurstone Scales toward *Sunday Observance*, *Church*, *God* (*a Reality*), and *God* (*Influence on Conduct*). Mean radicalism scores ranged from 36.92, S. D. = 6.75, for those who had chosen banking as an occupation, to 29.25, S. D. = 7.95, for those who had chosen journalism. The authors conclude,

> Students who have chosen as their vocation banking, dentistry, music and government service are more conservative, whereas the liberal attitudes are found among those planning on journalism, social work, law, and agriculture. Those choosing the ministry are the most religious and the most favorable to their college.

A more recent study by Berdie (**4**) showed that on the Minnesota Personality Scale, high school graduates choosing business as a vocation had significantly higher morale scores than students not choosing business and students choosing engineering had significantly lower social adjustment scores than students not choosing engineering. Students *choosing* engineering had significantly higher masculinity-femininity scores and significantly lower occupational level scores on the Strong Vocational Interest Blank than students not choosing engineering. Although the evidence is not abundant, there can be little doubt that people with different vocational choices can be differentiated upon the basis of other measurable aspects of personality.

Evidence is more plentiful concerning the relationship between measured vocational interests and other personality dimensions. In a study of 52 men, Sarbin and Berdie (48) found that groups differentiated upon the basis of certain interest patterns on the Strong test had significantly different profiles on the Allport-Vernon Study of Values. Correlations ranging up to +.45 between the Allport-Vernon test and the Strong test were found by Duffy and Crissey (16) using 108 college women as subjects. These results have been verified in a more recently reported study by Ferguson, Humphreys, and Strong (21).

The relationship between measured interests and other personality test scores has been investigated by Darley (13). Using 1000 pre-college and college men as subjects, he found that groups with different interest patterns on the Strong test could be differentiated upon the basis of scores on one or more of the following scales:

Economic Conservatism of the Minnesota Scale for the Survey of Opinion.
Social Adjustment of the Bell Adjustment Inventory.
Social Preferences of the Minnesota Inventories of Social Attitudes.
Social Behavior of the Minnesota Inventories of Social Attitudes.

In another study of 577 college freshmen, Darley (12) found correlation ratios ranging from .05 to .41 between the five scores on the Minnesota Personality Scale and six representative keys of the Strong test. Of the 30 correlation ratios, 10 were large enough to indicate a statistically significant relationship. Five of these were between the Social Adjustment section of the Personality Scale and the Strong test. These were:

| | |
|---|---|
| Chemist's Key | .16 |
| Carpenter's Key | .25 |
| YMCA Secretary's Key | .30 |
| Life Insurance Salesmen's Key | .41 |
| Lawyer's Key | .16 |

Darley's study indicates a substantial relationship between measured sociality factors of personality and measured vocational interest and supports Strong's suggestion that one of the factors measured by the Strong Interest test might be related to social behavior.

Students having "A" on the teachers' key of the Strong test had significantly higher adjustment scores on the Thurstone Personality test and higher extrovert scores on the Laird test than students having "C" on this key, according to a study by Goodfellow (26) on 172 students in education. These results are in agreement with the results obtained by Berdie (4) in comparing students having an interest pattern in the social service fields on the Strong test with students not having this pattern. On the emotional adjustment key of the Minnesota Personality

Scale, the group with the interest pattern had a significantly higher mean score than the other group, the critical ratio being 3.47.

The available information supports the statement that both measured and expressed vocational interests are consistently related to independently determinable aspects of personality. At the present time, interests cannot be attributed to these other personality characteristics. Rather, they should be regarded as an expression of a basic personality structure, susceptible to the same influences as are other expressions of that structure.

## V. Conclusion

Vocational interests, both as measured by tests and as indicated by occupational choices, are expressions of liking and disliking as directed toward activities, objects and characteristics of the environment. The available information suggests that vocational interests, while being relatively independent of conditions residing in the social environment and of conditions intrinsic in the individual, are still a function of these conditions. No one factor—ability, school, or work experience—plays a large part in determining vocational interests, yet all of these factors are related to interests to some extent. As personality is a complex phenomenon resulting from a multiplicity of conditions, so are vocational interests.

The studies reviewed indicate that family influences are among the more effective factors determining interests and that abilities are among the least effective factors. Conditions associated with the individual's school life, if adequately manipulated, can perhaps be influential in determining interests. The importance of organic and physiological differences in explaining vocational interests is a problem almost completely neglected.

The relationships between vocational interests and other personality manifestations present many intriguing problems. When interests are considered as expressions of liking and disliking, attention can be paid to the objects liked or disliked. These objects form constellations; they have certain characteristics in common that enable us to place them in classes. Such constellations might be found in athletic activities, or artistic endeavors or acquisitive proclivities. A factor analysis of the Strong test would show a definite clustering. Thus persons liking tennis might also like squash or at least, not dislike it. Persons liking talkative people would not express a preference for quiet people.

The general outlines of these constellations remain relatively constant and they may be considered as fundamental aspects of personality. The specific interests, or objects involved in the constellations may change and superficial learning and emotional experiences may affect them. The constellations, or patterns of interest, are not as susceptible

to these experiences and are perhaps determined by constitutional and early social factors.

Viewing interests in this light leads to a hypothesis. A process of generalization, which may or may not be verbalized or of which the person may or may not be aware, might play an important part in the development of these constellations or interest patterns. A boy who has had one unpleasant experience on an athletic field, say playing football, might generalize his dislike for football to other team sports, perhaps soccer. This generalization may be justified by further experiences on the soccer fields. On the other hand, the boy may actually be forced into playing soccer, and then discover he likes the game. Experience in this case may prove the prior generalization was fallacious.

These interest patterns are not as likely to be influenced by fleeting experiences as they are by conditions and situations enduring over long periods of time. An accident on a football field is not likely to cause the average boy to develop a distaste for football, but a series of such mishaps, accompanied by constant discouragement from parents and friends and greater emphasis placed by them upon other activities may result in a dislike for the sport. These continuing and enduring situations are the conditions determining not only those things liked and disliked by the individual but also many other of his personality characteristics and behaviors. The stability of interests and of personality is perhaps due to the relatively constant battery of stimuli surrounding the individual as well as to his genetic constitution.

Little doubt can exist that genetic factors do determine personality to some extent. Recent investigations of the effect of the glands upon personality, as well as studies of temperament in animals show that much behavior is related to factors we know are inherited. Interests are also determined to some extent by inherited factors, if only in so far as these factors determine sensory and attentive limens. Although a concept of the inheritance of specific interests appears somewhat ridiculous, when interests are conceived as personality patterns, this concept is more acceptable. A person may not inherit the ability to speak French but he may inherit something which determines whether or not he will be able to learn French easily or whether or not he will learn French more easily than Greek. A person does not inherit an interest in being a teacher but he may inherit something which will influence him to have an interest in types of work involving social contacts.

When vocational interests are considered as aspects of personality or in their relationship to jobs and occupations, the paucity of available information is apparent. Longitudinal studies, systematic clinical studies and extensive correlational studies are needed to supply the information so necessary for a more thorough understanding of the phenomena of vocational interests.

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# ON "THE ANALYSIS OF VARIANCE IN PSYCHOLOGICAL RESEARCH"

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Analysis of variance and kindred techniques developed by Fisher and his co-workers will very likely become valuable statistical tools in psychological research. Most of the psychologists who will use the analysis of variance cannot, however, be expected to follow in detail the mathematical developments lying behind the techniques involved. It may, therefore, be expected that psychological statisticians who attempt an authoritative presentation of such a technique to their less statistically sophisticated colleagues will: (a) provide a clear statement of the objectives of the methods, and (b) either restrict cited examples of use to those in which the methods are correctly used, or point out the errors in the analyses cited as models and examples.

In a recent article on "The Analysis of Variance in Psychological Research" (9) the emphasis is such as to obscure the primary objective of analysis of variance, and in addition, several experiments are uncritically cited although they violate major assumptions upon which the methods are based.

The aim of the present review is to clarify certain points in the original article and to correct major errors. Some of the minor slips may be pointed out in passing, but attention will be chiefly directed to more fundamental statistical inaccuracy. The review will follow the form of the original article.

## I. Meaning of the Analysis of Variance

The emphasis of the first section of the Garrett and Zubin article is misleading, and references are cited in which analysis of variance is inappropriately and inaccurately used.

Garrett summarizes the section by stating that " . . . no matter how complex the final analysis, the breakdown of the total variance into components and contributing variances is the essential objective of the method." This is like saying that the essential objective of finding a correlation coefficient is to compute the sum of cross-products. The impression is given here and in other sections of the article that the primary purpose of analysis of variance is to divide the total variance into two or more components (the mean squares) which are to be interpreted directly as the respective contributions to the total variance made by the

experimental variables and experimental error. Actually analysis of variance techniques are primarily concerned with *testing the significance of variation* that can be traced to known sources (10, 5, p. 62 ff.). It is possible, of course, to estimate the proportional contribution of different components to the total variance using the analysis of variance mean squares, but the process of *estimation* must be clearly differentiated from the test of *significance* (10). Rubin-Rabson (19) and Roff and Roff (18) confuse the two, and this, unfortunately, is not pointed out by Garrett when he cites their experiments as illustrative of the proper use of the analysis of variance.

The exact nature of analysis of variance and the assumptions upon which it is based may better be understood in the light of a concrete example. Suppose an experiment is to be carried out to discover the effects of method of learning upon the recall value of nonsense syllables. The variate would be some measure of recall; *e.g.*, number of syllables correctly given. Suppose that $N=rn$ subjects are used and that these subjects are assigned at random to $r$ experimental groups; a different method of learning is used with each group. Thus there will be $n$ subjects to each group. A recall score, $X$, is obtained for each subject; a mean recall score, $\bar{X}_i$, is computed for each of the $r$ experimental groups; and a general mean, $\bar{X}$, is computed for all $N$ subjects. Using this simple experimental design, three mean squares may be computed, one based upon variation *between the group means*, one based upon variation *within the groups*, and one based upon the two of these together. Such an analysis is presented in Table I.

TABLE I

SCHEMA FOR THE ANALYSIS OF VARIANCE WITH SIMPLE CLASSIFICATION OF VARIATES

| Source of Variation | Sum of Squares | Degrees of Freedom | Mean Square or Variance Estimate |
|---|---|---|---|
| Between Groups | $n\Sigma(\bar{X}_i-\bar{X})^2$ | $r-1$ | $V_B \rightarrow^* n\sigma_B^2+\sigma_p^2$ |
| Within Groups | $\Sigma(X-\bar{X}_i)^2$ | $r(n-1)$ | $V_W \rightarrow \sigma_p^2$ |
| Total | $\Sigma(X-\bar{X})^2$ | $N-1$ | |

* The arrow indicates *expected values*.

In Table I, it is shown that the "sum of squares" *between groups* is $n$ times the sum of the squared differences between the group means and the general mean, and the "sum of squares" *within groups* is the sum of the squared differences between the individual scores and their respective group means. When divided by the appropriate number of degrees of freedom, each "sum of squares" becomes a mean square, $V_B$ and $V_W$. *The mean squares are not variances in the ordinary meaning of the term.* On the assumptions of: (a) random sampling, and (b) homogeneity of

the group variances, the mean squares have expected values as indicated in the right-hand column of Table 1, where $\sigma_p^2$ is the population or universe variance of the variate, and $\sigma_B^2$ is the universe value of the variance between group means. Thus $\sigma_B^2$ is a measure of variation due to the experimental variable,—method of learning.

Using the common critical ratio technique, one would test the group means by pairs to see in each instance whether the hypothesis of a 'true' (universe) difference of zero would hold. In the above analysis of variance the same null hypothesis—no true variation between group means—is made. In other words, it is hypothesized that $\sigma_B^2 = 0$, and therefore $V_B$ reduces to $\sigma_p^2$ and should equal $V_W$ within the limits of random sampling variation. If a third assumption then holds; namely, that the universe distribution of the variate is normal, the sampling distribution of the ratio of the *between* to the *within groups* mean squares is known. The sampling distribution of the ratio of two independent, unbiased estimates of the same universe variance is tabled as the "F" distribution (21). If the experimentally obtained ratio is too great to be included within prescribed limits of the sampling distribution of "F," the hypothesis that $\sigma_B^2 = 0$ is rejected. Hence it is seen that as a test of significance this simple form of analysis of variance turns out to be an extension of the critical ratio or *t*-test so that the differences between several means are simultaneously tested.

In the Roff and Roff study (18) cited by Garrett, a slight modification of the simple design given above was used, but Roff and Roff made the error of comparing directly the sum of squares from between group variation with the sum of squares from within group variation to find whether differences between groups or differences within groups provided the greater portion of the total variation in their data. They would have been more nearly correct had they used $V_W$ as representative of variation within groups; to obtain the between groups variance ($\sigma_B^2$), $V_W$ should have been subtracted from $V_B$ and the difference should have been divided by the average number of cases per group. The procedure and interpretation is outlined by Tippett (23, pp. 126-130).

## II. Simple Classification of Variates

The writers should be pleased to discover that "F" and "z" have for some time been tabled for the .20 and .001 confidence levels (7) in addition to the .05 and .01 levels mentioned on p. 236. (More recently Merrington and Thompson (15) have presented tables of "F" for the .50, .25, .10, .05, .025, .01 and .005 levels.) They will not, however, find tables to evaluate the "F" of .5 which they computed from Schrader's (20) data, given on p. 238. "F" is so defined that it must always equal or exceed unity.

On p. 239, an analysis of variance based upon percentile scores (17) is presented without pointing out that it violates one of the basic assumptions of the method; *i.e.*, normality of the universe distribution of the variate! Such unnecessary violations should be discouraged even though it has been shown that the "F" test is not necessarily seriously invalidated by non-normal universe variation (**16, 4**).

Certain difficulties have been pointed out with reference to Dressel's (3) analysis (11), but these are not cited in discussion of the Dressel study on p. 239.

## III. Multiple Classification of Variates

The exact character of the analysis of variance when the variate may be classified into more than one set of groups can be illustrated in terms of an example. The experiment outlined earlier on the recall of nonsense syllables becomes more general if $k$ different nonsense lists are used. Each single list is then learned by all $r$ methods, and $rk$ subjects are assigned at random so that each subject learns a single list under a single condition. If the simple form of analysis of variance described above were used, the *within groups* mean square would be inflated by any variation in level of difficulty among the $k$ lists. Thus $V_W$ would tend to exceed rather than to equal the universe variance. Multiple classification, however, removes the influence of list heterogeneity from the data, permitting an unbiased estimate of $\sigma_p^2$.

The recall scores are arranged in $k$ columns, one for each list, and $r$ rows, one for each method, so that the score in the $i$th row and $j$th column belongs to the subject who learned the $j$th list by the $i$th method. If row means are denoted by $\bar{X}_{i\cdot}$, and column means are denoted by $\bar{X}_{\cdot j}$, the resulting analysis of variance is as given in Table II. On the assumptions of random sampling and homogeneity of variance for both rows and columns, the mean squares have expected values as indicated in the right-hand column of Table II. Here, $\sigma_r^2$ is the 'true' variance of

TABLE II

Schema for the Analysis of Variance with Multiple Classification of Variates

| Source of Variation | Sum of Squares | Degrees of Freedom | Mean Square or Variance Estimate |
|---|---|---|---|
| Row Means | $k\Sigma(\bar{X}_{i\cdot}-\bar{\bar{X}})^2$ | $r-1$ | $V_R \rightarrow^* k\sigma_r^2+\sigma_p^2$ |
| Column Means | $r\Sigma(\bar{X}_{\cdot j}-\bar{\bar{X}})^2$ | $k-1$ | $V_R \rightarrow r\sigma_k^2+\sigma_p^2$ |
| Interaction (Residual) | $\Sigma(X-\bar{X}_{i\cdot}-\bar{X}_{\cdot j}+\bar{\bar{X}})^2$ | $(r-1)(k-1)$ | $V_I \rightarrow \sigma_p^2$ |
| Total | $\Sigma(X-\bar{\bar{X}})^2$ | $N-1$ | |

* The arrow indicates *expected values*.

row means, and $\sigma_k^2$ is the 'true' variance of the column means. The new mean square, $V_I$, is the residual or intraction mean square. It is based

upon variation remaining in the data which cannot be accounted for in terms of the variations in the row and column means. As indicated in Table II, $V_I$ tends to equal the population variance.

With the further assumption of normality of the variate in the universe, the "F" test may be used, as in the instance of simple classification, to test the hypotheses that $\sigma_r^2$ or $\sigma_k^2$ are zero. In each case, "F"is the appropriate mean square divided by $V_I$.

Rubin-Rabson (19), cited by Garrett in Section I, used a multiple classification (somewhat more complicated than the above example). She erroneously compared directly the mean squares for her variables (individuals, methods, compositions, order, and residual) as measuring the relative contribution of each to the total variability. This assumes that a given mean square—*e.g.*, that for "methods" approximates the variance of the method means. Actually, as may be deduced from Table II, Rubin-Rabson's "method" mean square approximates $n\sigma_m^2+\sigma_p^2$, where $n$ is the number of measures taken under each method, $\sigma_m^2$ is the "true" variance of method means, and $\sigma_p^2$ is the population variance of the variate involved. Hence it should be immediately apparent that the size of each mean square is as much a function of the number of items within each class of a classification (*e.g.*, $r$ and $k$, in Table II) as it is a function of variability in means.[1]

On p. 242, Garrett cites his own study (8) in which an invalid test is made of the relative strengths of "practice variance" and "subject variance." The desired null hypothesis is that the universe values of "practice variance" and "subject variance" are equal. Unfortunately, however, the "F" ratio of "practice" to "subject" mean square does not provide a test for this hypothesis. The reason is the same as that given in connection with the Rubin-Rabson study above. It is as though the row and column mean squares of Table II were being compared. As can be seen in the right-hand column of Table II, the relative sizes of these mean squares is largely dependent upon the relative sizes of $r$ and $k$; hence, the "F" ratio would be large or small depending as much upon the relative magnitude of $r$ and $k$ as upon differences in the variability of the row and column means.

The logical structure of the analysis of variance is such that for an "F" test to be valid, one of the mean squares must be an estimate of the population or error variance.

## IV. The Latin Square and the Greco-Latin Square

For completeness, Zubin's section on the Latin Square and the Greco-Latin square needs a reference to the Fisher and Yates tables (7). This volume includes sets of the most useful standard Latin squares together with instructions on how to generate and select random Latin

[1] This obviously assumes that there is "true" variation in the means; *i.e.*, $\sigma_m^2 \neq 0$.

and Greco-Latin squares. Zubin's point on the necessity for transforming percentages used in the analysis of variance is well-taken and might have been considered elsewhere in the article. The arcsin transformation which Zubin proposes, however, has the disadvantage of a non-normal sampling distribution when $p$ differs from .50.

## V. Factorial Methods

Garrett's section on factorial methods is generally adequate. For the benefit of the unsophisticated, however, a reference to Fisher's *Design of Experiments* (5) would not be out of place, inasmuch as this book is a primary source of much of the material on factorial designs.

Crutchfield and Tolman's (2) enthusiasm for their factorial design (cited, p. 248) should have been curbed a trifle. The use of 243 animals permits evaluating each of the five single factors and the 10 two-factor interactions with the same accuracy that would have been obtained had separate groups of 195 (instead of 243) animals each been used for each comparison in the separate experiments. This follows because the error estimate is based upon 192, not 240 degrees of freedom (*cf.* p. 247).

## VI. The Applications of Analysis of Variance to Certain Special Problems

1. *Reliability of mental tests.* The section on application of the analysis of variance to the determination of test reliability is distinguished by a notable absence of references to original sources listed in the bibliography. On p. 249, the statement that if " . . . $F_2$ is significant, the test is a good measuring instrument, at least to the extent of separating individuals one from the other" is a bit too optimistic in the light of the facts. Using the $F_2$ test proposed by Garrett with enough forms of the test and enough subjects, significance of $F_2$ might be shown where the reliability coefficient was less than .20, a figure which is rather lower than most psychologists' reliability requirements for a "good measuring instrument."

On p. 251 it is stated, presumably following Jellinek (12), that a high intra-class correlation coefficient tells more about reliability than does a high inter-class correlation coefficient. This is a matter of interpretation. Sometimes it is necessary to measure reliability in terms of the correlation between two forms of the same test. This often involves some unavoidable practice effects increasing the general level of performance on the second test, and in this situation the interclass correlation coefficient, eliminating the practice effect, may give a truer picture of the consistency of measurement than the intra-class $r$. In other words, each coefficient has its own interpretation, and each still has its use.

4. *Item selection and validation.* In outlining Baker's (1) plan for evaluating test items, Garrett fails to heed Zubin's (p. 244) caution against the use of untransformed percentages in the analysis of variance.

## VII. Analysis of Covariance

The presentation of Zubin's section on the analysis of covariance is accurate in essentials. The reviewer does feel, however, that the lengthy paragraph differentiating between analysis of variance and factor analysis would have been unnecessary if Garrett and Zubin had been more cognizant of the fact that analysis of variance is primarily a technique to test the significance of variation rather than a method for "separating total variance into components." As it is, the distinction between the techniques is so great and so obvious that a lengthy discussion of the differences seems a trifle ridiculous.

A few points in the summary paragraphs are worthy of some critical attention. On p. 265 homogeneity of row and column variance is proposed as a suitable criterion for the adequacy of random sampling. Although homogeneity of variance must be assumed in analysis of variance, homogeneity alone provides no proof of the adequacy of the sampling.

Under "*Secondly*" on p. 265 it is suggested that the variability of data in which a single individual's score appears more than once " . . . must be separated into two parts: inter-individual and intra-individual variance." Of course, analysis of variance does not separate variance into parts. For this reason, and for reasons beyond the scope of this review the problem of repeated measurements on the same individual cannot always be solved simply by computing a mean-square for individuals. In some instances the proposed procedure leads to a very puzzling situation. An (interaction) estimate of the population variance may appear to be based upon many more degrees of freedom than there are independent measures in the raw data. This situation occurs in the cited study of Rubin-Rabson (19).

Under "*Thirdly*," it is bluntly stated that classification criteria must be independent in order to obtain an error estimate in the analysis of variance. If this were true it would lead to the following interesting paradox. In many instances, correlation between the classification criteria is discovered only when the interaction mean square is found to be too large. But if there is no error estimate available, how is it possible to find a significantly large interaction? The answer is that an error estimate may always be obtained from replications of the experiment with *additional* subjects (*cf.* 21, p. 40 ff.) even though classification criteria or classification variables are correlated.

The generally enthusiastic tone of the article is well illustrated by the closing paragraph in which it is cheerfully stated that Pearson (16) has concluded that "even when *some*[2] of the above requirements are not rigorously adhered to, the results of the analysis may still be meaningful." Pearson's study dealt with only *one* of the "above requirements", normality of the universe distribution of the variate!

In concluding, a few positive suggestions may be made. The psychologist who intends to use analysis of variance (or any other statistical technique) should acquire a thorough understanding of the method, preferably under expert guidance. General sources, other than Fisher (6), which the reviewer would recommend as giving understandable and accurate accounts of analysis of variance include the books of Tippett (23), Snedecor (21, 22), and Lindquist (13). Of these, the last named, though plagued by minor errors,[3] is essentially accurate and should be understandable to almost any patient reader. Walker's article (24) on degrees of freedom is very helpful on that concept. More precise and deeper understanding of analysis of variance may be gained from Irwin (10), but this reference requires considerable mathematical background in the reader. Finally, although the reviewer believes that widespread use of statistical methodology should be encouraged, he would suggest that an *understanding* of the relevant chapters of Fisher's *Statistical Methods for Research Workers* is not too strict a prerequisite to actual *use* of these methods.

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[2] Italics mine.

[3] Which have been corrected in McNemar's review (14) and on the lithographed list of corrections provided with the book.

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## PSYCHOLOGY AND THE WAR

Edited by

DONALD G. MARQUIS

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# PLACEMENT TESTING OF THE CIVILIAN PERSONNEL IN THE AIR SERVICE COMMAND

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The Air Service Command was established as a separate division of the Army Air Forces in October, 1941. The function of this Command is to provide for the maintenance and repair of the planes and equipment of the Army Air Forces, and to arrange for the procurement and distribution of the services and supplies necessary for this maintenance and repair. Since November, 1942, Major General Walter H. Frank has been Commanding General of the Command. In the continental United States, the work of the Command is carried on through eleven major repair bases, or depots, and their satellite installations. Civilian employees of the Command throughout most of 1943 numbered more than 280,000. Roughly 40% of the employees are engaged in maintenance and repair work, 30% in clerical, administrative, or professional work, and the remainder in miscellaneous other types of work—firefighters, guards, packers, laborers, supply, etc.

The Personnel and Training Division, Headquarters, Air Service Command, of which Brigadier General E. E. Adler is Chief, is in charge of all matters pertaining to personnel. For civilian personnel, such matters are handled by the Civilian Personnel Section of this Division under Colonel Joseph L. Whitney. The Classification Branch of this Section is responsible (1) for allocation of the civilian employees to the

proper service and grade, in terms of their duties and responsibilities; and (2) for the development and administration of testing programs for improving the placement of the employees. This latter function is performed by a Placement Testing Unit, which has been in operation since March, 1942. The purpose of this paper is to present a general description of the Work of this Testing Unit; no attempt will be made to set forth the details of any of its research projects, nor to summarize all the data accumulated.

*Functions of the Testing Unit.* The work of the Testing Unit embraces the following four functions:

(1) The development of aptitude, trade information, performance, and such other tests as prove helpful in the proper placement of civilian employees, and the adaptation of tests produced by other agencies, to meet Air Service Command needs.

(2) The establishment of testing programs in the major depots, and the training of personnel in these depots in the administration of the programs. In some instances members of the Headquarters staff have been permanently detailed to the depots to direct the programs there.

(3) The coordination of the testing programs conducted in the various depots, and summarization and analysis of data from all the depots. In this connection the unit serves as a clearing house* through which the data and experience obtained in any one depot are made available to all the other depots.

(4) Provision of advisory service to depots and sub-depots, either through personal consultation or correspondence.

The services of the Testing Unit are made available to all interested groups within the Command, including employment officers, training officers, supervisors, employee relation counsellors, and others. The Headquarters staff has numbered at times as many as 16 technicians, all but two of whom have had training in psychology and/or experience in test construction. At present, however, there are only five staff members, due to transfers of technicians to depots, losses to the armed services, and other reasons. Practically all the test construction work to be described hereafter was carried on at Headquarters, Patterson Field, Fairfield, Ohio, although most of the subsequent research on the tests was conducted in the depots. At the time of writing, the Headquarters technical staff includes Dr. Brent Baxter, Mr. Claude Bridges, Mr. Edward Sait, and Miss Evelyn Potechin, in addition to the author. The directors of testing programs in the depots include the following:

Dr. J. S. Karslake, Warner Robins Air Service Command, Macon, Georgia.
Mr. G. G. Lane, Spokane Air Service Command, Spokane, Washington.

* It should be mentioned here that in at least two depots, testing programs had been in operation independently of, and prior to, the establishment of the Testing Unit at Headquarters; both of these independent programs produced much worthwhile test material and research. Provisions have been made for integrating their work with that of the Headquarters Unit. This report, however, will be concerned only with projects initiated by or conducted under the supervision of, the Headquarters Unit.

Dr. Vernon Larsen, Ogden Air Service Command, Ogden, Utah.
Mr. W. Woodworth, Rome Air Service Command, Rome, New York.
Mrs. L. Hart, Sacramento Air Service Command, Sacramento, California.
Mr. J. Banarer, San Bernardino Air Service Command, San Bernardino, California.

With this brief overall summary of the functions of the Testing Unit in mind, it is possible to proceed to a more detailed consideration of some phases of the work. Since the work of test construction, or adaptation of already existing tests, was one of the first activities undertaken by the Unit, it may be well to discuss this phase of the work, under two headings—first, the construction of tests for initial placement of incoming employees, which may loosely be termed the "aptitude test" program; and secondly, the construction of trade information and performance tests designed for use in upgrading shop employees who have been in the service for some time.

*Aptitude Test Program.* The aptitude test program has included the development of tests for use in the initial placement of both mechanical and clerical workers. Because of the war-induced manpower shortage, the vast majority of individuals hired for aircraft maintenance and repair positions were inexperienced in aircraft work, and included a large percentage of women workers inexperienced in mechanical work of any kind. In order to avoid waste of considerable time and expense in training individuals who would eventually prove unsuccessful on the job, and to make the best possible utilization of the available labor supply, there was need of some means of indicating the approximate level and kind of work for which an individual was qualified. For this purpose, a series of tests was developed, intended to predict success in mechanical work. Following a review of the available tests and of the literature, including the experience of other War Department agencies faced with a similar problem, and after observation by the staff of the actual work carried on in the depots, and consideration of the job breakdowns provided by the classification analysts, a group of tests was produced, constituting a series of so-called "Selection Tests," as described below:

*Selection Test 1* is a 38-item test made up of a series of figure analogies, intended to measure one aspect of non-verbal intelligence. The test requires 15 minutes working time, plus about 5 minutes for directions. The educational level of many of the applicants was so low as to handicap them unduly on the usual verbal-type intelligence test, so that some non-verbal intelligence measure seemed desirable.

*Selection Test 2* is a 60-item non-verbal test, intended to measure ability to perceive details of size and shape. Working time on the test is 16 minutes.

*Selection Test 3* is intended to measure the ability to visualize the order in which parts must be fitted together in order to form a pictured solid, and the ability to visualize the solids that could be formed from an assembly of several pictured parts.

*Selection Test 4* was intended to measure ability to understand mechanical movements, and to recognize the kind of mechanism required to produce specified kinds of motion. This test proved too difficult for the level of applicants, and was abandoned after a few initial tryouts.

*Selection Test 5* is intended to measure the ability to visualize how parts of figures fit together into wholes. The test includes 48 items and requires 12 minutes working time.

*Selection Test 6* is a test of mechanical information and understanding of mechanical principles, made up partly of verbal and partly of pictorial material. It includes 77 items and has a working time of 25 minutes.

*Selection Test 7* is also a test of familiarity with mechanical objects and devices of greater difficulty than Test 6, and of a less general nature. It includes 62 items, and has a time limit of 20 minutes.

All these materials have been subjected to experimental tryouts, and their validity appraised in terms of their ability to distinguish between good and poor groups of shop workers, or of shop trainees, the extent to which they correlate with training school grades, and the extent to which they predict early termination for unsatisfactory work. No attempt will be made here to summarize the findings with respect to any of these tests; however, it may be stated that Selection Tests 6 and 7, up to the present time, seem the most promising of those listed, and that Selection Tests 1 and 5 also appear to have some validity for the purposes described.

In addition to the tests listed above, there is used with applicants for mechanical positions a so-called *Learning Ability Test* which is a 90-item self-administering verbal intelligence test requiring 30 minutes of testing time. It is composed of items adapted from the Kansas revision of Army Alpha, and of items developed by the Testing Unit. This test has now been standardized on thousands of applicants for positions in the Command. Data have been accumulated indicating that the test is functioning well in the prediction of success in mechanical work. Furthermore, arrangements have been made with the War Manpower Commission for use by Air Service Command activities, of tests developed by Occupational Analysis Section of the U.S. Employment Service. The USES tests which have thus far been used include tests of knowledge of proper tools for specified tasks (designated as C-48 by USES), of ability to recognize the order in which pictured parts of familiar objects should be assembled (C-69), of surface development (C-70), and of block counting (C-93). Of these tests the ones which thus far appear most promising are C-70 and C-93.

Although not properly a part of the aptitude test program, it is appropriate to mention at this point that arrangements were also made for use of U. S. Employment Service Oral Trade Questions by Air Service Command activities, since these tests are used in connection with initial placement. However, as mentioned above, the number of experienced personnel applying for positions, for whom such tests would

be applicable, has been so small that the use of these tests has been rather limited.

All of the above-mentioned tests are paper-and-pencil tests. A question will naturally arise as to the apparent lack of emphasis on the motor or manipulative aspects of mechanical aptitude. Two depots which were conducting testing programs independently of the Headquarters Unit have used a variety of manipulative and dexterity measures, but the Headquarters staff has devoted very little of its time to such materials. It has been the attitude of the staff that the added information which might be yielded by such measures was not sufficient to compensate for the difficulties in the production, development, and administration of such tests; nor has there been found in the literature or in discussions with other agencies which have worked in this area, evidence to contradict this point of view. An essentially similar point of view prevails with reference to personality tests.

The problem of validation of aptitude test materials such as these is, as is well known, a most difficult one, not particularly because of a lack of suitable techniques, but because so many factors beyond the control of the test technician limit the application of the techniques. If an attempt is made to validate the tests in terms of prediction of training school success, it is characteristically found that the only grades available are based on essay type examinations of questionable reliability. If the validation is in terms of success in the shop, it must ordinarily be in terms of foremen's ratings or rankings of the efficiency of the workers, which are notoriously lacking in both reliability and validity. In either case the size of the groups on which the validation studies must be conducted is usually small, since at any given depot the number of workers performing any particular kind of work, or in any given training course is not large. Since the shop workers are engaged in a repair and maintenance task rather than a production task, there are very few groups for which it is possible to obtain a product criterion. Separation rates may also be used as criteria, but at best these are ambiguous indices of success, since they are influenced by so many factors that are unrelated to the abilities of the workers—for example, housing and transportation conditions, salary, etc. In spite of these recognized imperfections, however, all the above types of criteria have been employed in the validation of Air Service Command tests, since they were the best available criteria at the time. It is anticipated that more adequate criteria in the form of objective-type trade information and performance tests will be available in the future as a result of construction of such tests as described below.

Efforts have also been made to improve the placement of clerical workers through the use of a Clerical Aptitude Test, a Stock Checking Test, and a Supply Record Test, all of which have been developed by

the test construction staff, together with the above-mentioned Learning Ability Test.

The *Clerical Aptitude Test* includes 6 separately-timed sub-tests—alphabetizing, file coding, digit counting, number checking, arithmetic computation, and locating information from tabular data. It requires about 30 minutes of working time. A self-administering form of this test, incorporating three of the more valid types of material of the longer form has also been developed and is gradually supplanting the longer form of the test. The *Stock Checking* and *Supply Record* tests measure the ability to perform simple stock inventory and record tasks, and approach the nature of work samples.

Considerable data have been accumulated on the validity of the Clerical Aptitude and Stock Checking tests, both in terms of prediction of grades in training schools for clerical employees, and in terms of correlations with supervisors' rankings or ratings of employees.

It is planned to make more widespread use of a series of tests covering more specific clerical abilities—for example, filing, posting, checking, spelling, language usage, and arithmetic computation, and a test on military correspondence, which involves special forms and rules with which typists and stenographers in Air Service Command stations must be familiar. Use of these specific tests in conjunction with information about the specific abilities required in various classes of positions should make possible improved matching of job and worker.

*Trade Information and Performance Test Program.* In addition to the development of tests for use in initial placement, one of the earliest assignments of the Testing Unit was the task of constructing trade information and performance tests to assist in the proper placement of civilian personnel in the maintenance shops. These tests were intended to measure the knowledges and skills required for properly discharging the duties and responsibilities of the various classes of positions and thus to afford a more objective basis for promotions, transfers and other personnel transactions than would otherwise be available. Some idea of the magnitude of the task may be gleaned from the facts that there are more than 200 different kinds of work in the shops, and that more than one test would be necessary in many of these areas to provide for different levels of work, even of the same general sort.

To date, test items have been constructed in approximately 60 areas of work, covering the basic information required by the workers in these fields. Some of the areas in which work has been done are listed below:

Aircraft Dissassembler
Aircraft Final Assembler
Aircraft Battery Servicer
Armament Servicer
Bench Worker
Blacksmith
Block Tester
Carburetor Service
Aircraft Crankcase and Crankshaft Servicer
Cylinder and Piston Repairer
Electrical Instrument Servicer

Electrical Equipment Installer
Maintenance and Construction Electrician
Electroplater
Engine Assembler
Engine Disassembler
Engine Installation
Fabric, Canvas and Leather Worker
Magnaflux Operator
Metal Fittings and Small Parts Manufacturer
Flight Test Servicer
Foundryman
Fuselage and Metal Surface Repairer
Generator Servicer
Safety Glass and Plexiglas Worker
Grinder
Gyroscope Servicer
Heat Treater
Hydraulic Equipment Servicer
Hydrostatics Servicer
Landing Gear Installer
Engine Lathe Operator
Machinist
Magneto Servicer
Milling Machine Operator
Navigation Instruments Servicer
Optical Instruments Servicer
Brush, Spray and Stencil Painter
Parachute Rigger
Patternmaker
Pressure Instrument Servicer
Propeller Servicer
Radiator and Cooler Servicer
Sandblaster
Screw Machine Operator
Seamstress
Shaper and Planer Operator
Sheet Metal Manufacturer
Sheet Metal Repair
Spark Plug Servicer
Starter Servicer
Supercharger Servicer
Metal and Rubber Tank Servicer
Watch and Clock Repairer
Welder
Wire and Cable Servicer
Wire Manifold Servicer
Wood Surface Repairer
Woodworker

The materials have included true-false, multiple-choice, matching, completion and picture items, although the majority of the material constructed to date has been of the multiple-choice and true-false type. The material for these tests has been obtained from a variety of sources, including the following:

*a.* Instruction Manuals, textbooks and other materials used in the training schools in courses preparing for work in the shops.

*b.* Technical Manuals prepared by the War Department on many phases of the work done in the shops.

*c.* Technical Orders issued by the Air Service Command governing maintenance and repair of Army Air Forces equipment.

*d.* Manufacturers' handbooks, covering the maintenance and repair of their products.

*e.* Observation and analysis of the work in the shops, and discussion with foremen, training school instructors, and workers as to the nature, organization, and difficulty of the work.

*f.* Consultation with classification analysts who had completed occupational analyses of the work prior to the start of test construction work. The work of the classification staff proved most useful in this connection, since it indicated not only the specific tasks performed by the workers of a given class but also the approximate amount of time spent by the workers on each of these tasks; this served as one index of the relative importance of the different tasks.

The procedure finally adopted in developing a test for a given class of positions was as follows: The test author first became familiar with

the content of the field by reference to the sources listed above, and then proceeded to write test items covering what he thought to be the most important phases of the work. All items were then edited from the standpoint of suitability of language, freedom from ambiguities, adequacy for measuring purposes, and technical accuracy. The materials were next submitted to the one or more foremen of the appropriate department in the shops, who went over them, item by item, with the test author. The items were then revised in the light of the foremen's criticisms, and new material prepared to cover areas which the foremen felt were inadequately sampled in the original material, and to replace discarded items. These revised test materials were administered to as many workers as possible in the class in question, and difficulty and validity measures computed for the items. The next step was to prepare a second experimental edition of the test and submit this newly revised form to another group of workers, again determining the validity and difficulty of the material. Ratings or rankings were obtained from the foremen for all the workers tested, which were used as a criterion against which the test was validated. After a sufficient amount of material had been thus tried out so that the items remaining after analysis constituted an adequate sample of the field, the test was considered ready for standardization. Relatively few tests have as yet reached this stage. Standardization presumably will be accomplished by administration of the tests at all the depots. No tests have as yet gone through this final step of standardization.

The above brief summary of the test construction procedure scarcely suggests the innumerable difficulties and obstacles which arose at almost every step. It is not pretended that anything like adequate solutions have been found for many of these difficulties. Some of these difficulties are mentioned here so that others involved in similar programs may be aware of the troubles which are likely to beset them.

In the first place, it was probably to be expected that trade information items produced by test writers having little or no experience in mechanical work, however thoroughly these writers attempted to familiarize themselves with the work, would have a high mortality; and such indeed proved to be the fact. The percentage of items which had to be revised or discarded in the light of the foremen's criticism and subsequent tryout often approached, and sometimes exceeded 50. It has become thoroughly clear that the price of valid and insightful item construction is extended and painstaking analysis and observation of the work, and thorough discussion with those who know the work.

Secondly, there has been the ever-present problem, mentioned in connection with the aptitude tests, of obtaining satisfactory criteria against which to validate the tests. The test construction group has at times found itself in the anomalous position of accepting as criteria

foremen's estimates of subordinates' work, although the test was intended to supplant the subjectivity of these very estimates—a situation reminiscent of the efforts of early intelligence testers to validate their instruments against teachers' estimates of brightness. The foremen's ratings may be in error for a variety of reasons, some of them common to rating scales in general and others of them specific to the shop situation, but generally speaking, they were the best estimates available of the abilities of the workers. Some of the difficulties inherent in the use of foremen's estimates as criteria can be minimized by supplementing sheer rankings, or formalized ratings, by rather thorough discussion with the foreman who rates the workers, of his reasons for rating them as he does. The rankings or ratings, and their correlations with the test scores, can then be interpreted in the light of this supplemental information. This procedure, however, is somewhat subjective, and cumbersome where sizable numbers of cases are involved. As a matter of fact, it is quite possible that the tests themselves in some instances furnish more valid estimates of the abilities of the workers than do the foremen's rankings, assuming that the tests have been reasonably well conceived and executed. It has been interesting to observe how readily some of the foremen accepted the test rankings as more accurate than their own judgment of the men's abilities and it is noteworthy, too, that foremen in general welcomed some objective means by which they can be guided in the evaluation of their subordinates. Foremen sometimes do not have sufficient opportunity to observe the men under them to permit an accurate evaluation of their merits, and they appreciate some means whereby they can quickly and accurately appraise the new workers who are continually being assigned to them.

In the third place, it has been necessary to do most of the work of validating with samples which, when judged in the light of the numbers of cases ordinarily used in development of standard tests, are ridiculously small. Unfortunately for testing purposes, the number of milling machine operators, or landing gear installers, or parachute riggers at any given depot is rather small, and the magnitude of the sampling errors involved in most of the test construction work of the Unit is at first a little disturbing to one accustomed to working with hundreds or thousands of cases, as is true with most educational tests. The size of the sample is, however, an element beyond the control of the test constructor and simply places on him the burden of using with the utmost care those small numbers of cases which are available. This difficulty will be overcome to some extent by accumulation of data over a long period of time, and by collecting data from several or all depots.

Another source of difficulty has been the rapidly changing character of the content with which the tests deal. Airplane engines, parts, and accessories are in constant process of improvement, and it is all but im-

possible, in some cases, for the test constructor to keep his material abreast of changing conditions in the shops. To mention one instance, one member of the staff spent considerable time developing test materials for carburetor servicers, only to discover that the type of carburetors on which he had been preparing items had become obsolete almost while he wrote. Fortunately, this is an extreme illustration, but the content in virtually every field is subject, to greater or less degree, to continual change.

The last difficulty which we shall mention is a practical one, arising from the difficulties attendant upon interrupting the vital work of the ground crew personnel of the Army Air Forces. For obvious reasons, the amount of time which foremen and workers can be asked to take from the performance of their duties to cooperate in test development research must be kept at a minimum, and this circumstance has conditioned the speed and thoroughness with which it has been possible to advance the work. It should be stated that in general the foremen and the workers have been found most willing to cooperate in the development of the test material when the purpose and significance of this work was properly presented to them. Many of the foremen have gone over the test materials on their own time and have been most helpful in arranging their work so as to facilitate the administration of tests.

The construction of these trade information tests has been carried on chiefly by Dr. Brent Baxter, Dr. William Biel, Dr. Ruth Cruikshank (prior to her enlistment in the WAVES), Dr. Walter Durost, Dr. James Karslake, Mr. Edward Sait, and Miss Evelyn Potechin.

Although the essential role which performance tests must play in the proper placement of shop personnel has been recognized, the staff has devoted much less of its time to the production of performance tests than of paper-and-pencil tests, with the result that progress on the development of the performance tests has been rather slow. To date, in fact, performance materials are available in only about a half-dozen fields. In general, development of these materials has followed the same pattern as the development of the paper-and-pencil materials. It has involved the added task of planning and arranging for the production of the materials themselves in the shops, difficult because of the undesirability of interrupting the regular work of the shops. The development of these performance tests has been largely the responsibility of Mr. Claude Bridges, Dr. Walter Durost, Mr. Richard John, Dr. J. Karslake, Mr. David Ekberg, Mr. C. Quick, and Dr. A. S. Switzer (prior to Dr. Switzer's commissioning in the Army Air Forces).

The development of these upgrading tests, both information and performance, has been virtually at a standstill during the past year, partly because the staff has had to devote its time to the more urgent

problems of initial placement, but even more because the labor situation in the shops was one of excess of demand for skilled workers over available supply, so that many operating officials felt that the standards for upgrading to higher-level positions could not be maintained as high as would normally be desirable. At the time of writing, however, it appears likely that there will be a renewal of activity in the upgrade testing program. As a result of decreased turnover, of extensive training programs and of general stabilization of the labor situation, the time is approaching when the supply of skilled labor will equal or exceed the demand, and it will again be desirable to specify the possession of certain knowledges and skills as prerequisites for promotion.

*Typical Uses of Aptitude Tests at Air Service Command Stations.* To understand the role which the Air Service Command tests play in placement, it is necessary first to recognize that Air Service Command is a Federal agency, and consequently all recruiting and selection of civilian employees is the responsibility of the Civil Service Commission. Thus all prehiring testing is the function of the Civil Service Commission, and the agency may use its tests only for proper placement of individuals who have already been hired. An exception to this general rule exists in case of mechanic learners and general mechanic helpers, which are the two lowest designations of aircraft maintenance workers. In the case of these two classes the Commission had recognized the right of Air Service Command to reject, on the basis of its tests, applicants who otherwise meet Civil Service requirements. Since individuals are certified by the Commission and hired at specific levels, the possible utilization of the test results is reduced to placement within one or another position within the specified level; however, there is a sufficient variety among the positions at a given level so that the test results can be used effectively in improving placement. In the case of mechanic learners and general mechanic helpers there is a tremendous variety of level and kinds of work or training courses to which they may be assigned and for this group the use of some tests for placement purposes becomes almost indispensable.

There is a sufficient variation in the organization and functioning of testing programs at the several depots to make it difficult to describe any "typical" program, but certain aspects are more or less common to all. The incoming applicants may be grouped roughly into those with experience relevant to the requirements of some position which is open, and those without such experience. Placement of the former group may ordinarily be made fairly readily on the basis of their experience, with tests serving only to verify the applicants' claims of qualifying experience. Placement of inexperienced applicants, however, is a more difficult task. The practice has generally been to assign all inexperienced shop workers to training school prior to assignment to the shops; thus

it was desirable both to identify those who would be unlikely to profit appreciably from any formal training, and to determine the kinds of training courses (and eventually of work) for which each applicant was best suited. Tests are typically given to the applicants prior to assignment to a course, sometimes in connection with a preliminary orientation program. The training school courses, or classes of positions in the shops, to which assignments may be made are grouped into four or five levels of difficulty, ranging from very simple work such as spark plug servicing, or washing and cleaning of parts, to the most difficult kinds of work, such as instrument repair or certain armament repair. Then, on the basis of the test results, the applicants are likewise grouped into several ability levels and recommendations are made such that the most capable applicants are assigned to the most difficult types of work. Naturally, it is not always possible to effect an ideal matching of job and worker because of the limitations imposed by the numbers of positions open at the various levels; but it is possible to avoid in this way gross misplacements that would almost surely lead to failure on the job or waste of time. The estimation of the difficulty of the various kinds of work or of the training school courses is made possible by careful consideration of the information obtained by the classification analysts, discussions with foremen and shop superintendents, and consultation with training school instructors.

No attempt has been made to develop tests so specific that they will predict success in very narrow fields, such as propellor repair, parachute rigging, bombsight servicing, etc. While it is possible that the abilities required for success in each and every kind of work could be differentiated, this is not a task that could be accomplished in the limited time that was available.

A similar system has been developed for the placement of clerical workers; the various classes of clerical positions have been ranked in terms of difficulty and employees are assigned to work of given difficulty in accordance with abilities as revealed by the test.

*Use of test results by supervisors.* It has always been one of the aims of the Testing Unit that the use of test results should not stop with initial placement but should continue as a factor in all subsequent decisions affecting the reassignment or reclassification of the individual. To this end provision has been made for having the test results, in the form of percentile ranks, follow the worker into the unit to which he is first assigned so that the supervisor may have the advantage of this information in his dealing with the employee. Such a program naturally is ineffective unless the supervisors are trained in the use of the test results. To provide such training, literature has been prepared for distribution to supervisors describing the significance of the test results and indicating to them how they may be used in improving the place-

ment of their workers. An outline has also been prepared of a brief course in the use of test results, to be given to supervisors as part of the War Manpower Commission supervisor-training courses now being conducted at almost all the depots. A similar program is contemplated for those employee relation counsellors who do not already have sufficient background in the use of tests.

*Handbook on the Use of Tests.* A "Handbook on the Use of Tests in the Placement of Clerical Personnel" has been prepared which sets forth in simple, non-technical language the purposes which tests may serve, and the way in which they may be used in improving placement. This Handbook was designed to assist the personnel officers in stations too small to warrant the employment of a trained testing technician, as well as for the benefit of all personnel who might have occasion to use test results, but who did not have psychological training or experience in the field. At the time of writing, some 1200 copies of this Handbook have been distributed.

*Other activities.* The services of the testing units at the various depots have been enlisted in connection with a variety of problems in addition to their regular duties. Testing of the personnel in branches or sections where special placement problems exist has sometimes been requested by the officer or supervisor in charge; testing of military personnel attached to the depots or nearby stations has been undertaken when requested; individual testing has been done in connection with transfers or reassignments. Assistance has been afforded to training instructors in the construction of examinations for their courses.

A recurring problem has been that of interpreting and selling to supervisors and others, untrained and inexperienced in this field, the uses and possibilities of psychological tests, and of convincing operating officials of the advantages of making more extensive use of test results in personnel transactions. This problem has been complicated by the difficulty of obtaining the kind of evidence most likely to impress these people—dollars-and-cents indications of the savings, in terms of reduced turnover, or decreased training time, or more efficient workers, made possible by proper use of tests. In general, however, almost all officials have been found sympathetic to the concept that psychology can make a genuine contribution to the solution of some of their personnel problems, and it is believed that the work herein described has tended to confirm their belief in this concept.

# THE PERSONNEL CONSULTANT IN AN ARMY TRAINING CENTER*

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*Personnel Consultant*

Previous articles in the *Psychological Bulletin* have described how the Personnel Research Section, Classification and Replacement Branch, The Adjutant General's Office, has contributed to setting up the Army's classification system and personnel procedures. The present paper is intended to describe from first-hand experience how one psychologist, like many others, has functioned in one important aspect of personnel administration in the field: acting as Personnel Consultant in an army training center.

During the training period, all men must be classified and trained in the military duties for which they are best fitted; civilian skills and temperaments must be adjusted to war-time needs; misfits must be eliminated; and numerous other problems of a more or less psychological nature must be met as they arise. There are no two training centers in which the duties of the Personnel Consultant are precisely the same, since these are dependent on the problems and requirements of the command to which he is assigned as well as his own qualifications and adaptability. However, the following directive, issued at headquarters where the writer was assigned, will serve as an example of the duties assumed by a Personnel Consultant in a training center of the Army Ground Forces:

## OFFICE OF THE PERSONNEL CONSULTANT

The Office of the Personnel Consultant operates as a liaison unit of the Classification Office, Hq AAATC, to facilitate consultation and action on personnel problems, reclassification, and testing . . . . The following matters are referred to the Personnel Consultant:

1. *All possible Sec. VIII cases (AR 615–360)*: Cases of suspected or demonstrated inaptitude, undesirable habits or traits of character, or lack of adaptability will be examined by the Personnel Consultant, and appropriate recommendations made. Where Sec. VIII is recommended, the report will constitute expert testimony and Proceedings of Board of Officers will be submitted to Hq AAATC within 7 days after date of Personnel Consultant's report (see Administrative Memorandum Number 14 . . . .)

2. *AWOL and other offenders:* In order to reduce the repetition of AWOL and other Court-Martial offenses by proper guidance, as well as to eliminate chronic offenders and trouble-makers who do not possess the required degree of adaptability to military service, the following measures will be taken:

*a.* AAATC prisoners in the Camp Stockades will be interviewed periodically to determine fitness for service and future rehabilitation possibilities. Where Sec. VIII proceedings or psychiatric examination is recommended, appropriate action will be taken.

* The views expressed herein are those of the author and are not necessarily accepted officially by the War Department.

*b.* A follow-up of prisoners upon completion of sentence will be maintained by the Personnel Consultant for rehabilitation purposes. Wherever desirable, such men will be transferred to other units or otherwise reassigned and counselled in order to effect rehabilitation.

*c.* All second offenders, if not in the Stockades, should be referred to the Personnel Consultant by the Battery Commander for interview.

3. *Voluntary Consultation for EM:* Enlisted men may be referred to the Personnel Consultant by their Battery Commanders on any personal matters not of a religious or financial nature, particularly matters affecting their adjustment to the army and maximum usefulness to the service . . . . The facilities of the Classification Office will be used to make any advisable reassignments, transfers, selection for specialist training, etc. Information and guidance will be given with a view to promoting efficiency and morale. No formal referral required.

4. *Illiterate and Non-English:* If assigned to AAATC after July 15, 1943, they will be returned to Reception Center. A class is now being conducted in the Enlisted Cadre Pool under the supervision of the Personnel Consultant for the remaining illiterates assigned before that date. Admission to this class will be made only with the approval of the Personnel Consultant.

5. *Classification tests and retests:* Tests or retests on the AGCT, 2abc, Mechanical Aptitude, etc. should be arranged as far as possible in groups by appointment with the Personnel Consultant's Office or Classification Office. Individuals will be tested on Saturday mornings. A letter giving previous date, score, and type or form of test will be sent in advance in all cases.

6. *Maladjusted Individuals:* Cases of apparent shirking of duty, queer behavior, constant discipline, chronic alcoholism, and other evidences of maladjustment may be referred for consultation and guidance. Wherever possible, attempts will be made to determine the cause and institute corrective measures, or effect other appropriate disposition.

7. *Lectures on Classification, Personnel Problems, and Military Psychology* may be arranged for officer's schools, cadre schools, or orientation courses for non-coms or enlisted men.

By command of Brigadier General——

Although adaptability to military needs rather than academic accomplishment is the chief criterion of a psychologist's value to the service, his duties presuppose competence in at least two academic fields of psychology: (a) clinical (including testing and guidance) and (b) educational. A brief discussion will serve to describe the application of clinical and educational psychology to military needs.

## Clinical

One of the important clinical tasks of both psychiatrist and psychologist in an Army training center is the elimination of those mentally unfit for military service. Army Regulations provide two means of discharge for such cases: Certificate of Disability for Discharge (CDD), effected upon recommendation of a Board of Medical officers, and the "Sec. VIII" referred to in paragraph 1 of the above directive. Cases of psychosis, psychoneurosis, and other nervous disorders are disposed of by CDD. Under Sec. VIII, a large variety of other misfits are dis-

posed of. On the grounds of "inaptitude," the feebleminded who have been unable to learn any useful duty in spite of reasonable attempts at training are discharged. "Undesirable habits and traits of character" includes chronic alcoholics and drug addicts, some enuretics, inverts, etc. Finally, the general basis of "lack of adaptability" may apply to any of the above but includes in addition constitutional psychopaths and the emotionally unstable, as well as a variety of misfits and incorrigible trouble-markers without diagnosis, whose presence in the army is considered to be more of a hindrance than a help to the war effort. In all cases where a diagnosis other than feeblemindedness is required, psychiatric consultation is obtained before or after the Personnel Consultant's report is submitted to the soldier's commanding officer.

These reports are useful not only in guiding the board of officers charged with the responsibility of making the official recommendation for discharge but are of immeasurable value in facilitating psychiatric diagnosis even in cases for disposition under CDD. In either case, adaptability to military needs is the keynote of the psychologist's clinical function. It is obvious that extended psychoanalysis, exhaustive testing, and esoteric methods of personality evaluation have no place in the clinical setting of blitz warfare. The primary clinical function of determining fitness for service will ordinarily be satisified by a two-hour examination and a two-page report. In making his recommendation the military psychologist has several criteria and sources of information even more readily available than in civilian practice. These are:

1. *Soldier's Qualification Card* (Form 20): This card, the cornerstone of the Army personnel system, offers the psychologist much of the information he needs concerning any soldier's background and Army record at a glance. It includes information about his birth and parentage, education, civilian occupation, military classification and assignments, Army test scores, and various other useful data.

2. *Service Record:* This gives a fairly detailed account of the soldier's Army record. Of particular significance to the psychologist are reports on AWOL, court-martial convictions, confinements, and other "bad time."

3. *Commanding Officer's Report* is required and readily obtained on each case referred to the Personnel Consultant. Rarely in civilian practice is a responsible report from full-time, close, impartial observation so readily available. Where necessary, direct information from the soldier's companions can also be immediately secured.

4. *Tests.* The AGCT and other group test scores are already included on the Qualification Card. It is sometimes desirable, however, to have the results of an individual mental test. As with all mental tests, skill is required in adapting test to cultural differences in order to obtain valid results. This becomes particularly important in Army clinical practice, where one may be called upon to test an illiterate farmer from Tennessee, a Mexican migratory worker from Texas, a coal-miner from Pennsylvania, or a juvenile delinquent from a metropolitan slum, on one and the same day. The diversity of cultures which is the backbone of American democracy is also the bugaboo of military psychometrics. Tests are used more or less at the discretion of the psychologist, but as

previously pointed out, over-testing is discouraged. The writer has found the popular paper-and-pencil tests of personality traits not worth bothering with. In general, to complete the picture of social adjustment, motivation, emotional stability, altertness, and other personality factors relevant to the issue at hand, the psychologist must rely on—

5. *Interview.* This depends entirely on the examiner's skill and experience. It is necessary to fill in all the gaps in the soldier's background, health history marital and social history, habits, reactions to men and officers in his unit, and numerous other questions depending on the nature of the case. It also affords an estimate of personality characteristics insofar as these may be safely inferred from the interview situation. Where verification or additional information is required concerning the social history,— -

6. *Red Cross* investigation is available. This enables the psychologist or psychiatrist to obtain a report from a competent investigator in any part of the country and often determines a decision for action in the best interests of the Army as well as of the soldier in question. Frequently a behavior pattern which may look like a simple disciplinary problem in the army setting becomes symptomatic of mental instability when evaluated in the light of reported social history and behavior in civilian life. Follow-up for rehabilitation of those discharged is also a valuable Red Cross service.

With the above aids at his disposal, a psychologist with three or four assistants can handle a fairly heavy case load. Since only a small percentage of men in any training center become "problem" cases, one Personnel Consultant suffices in each camp. The writer's case load in a camp with a floating population of several thousand troops (exclusive of OCS students) was over 700 in a 9-month period in 1943, or about 1½ percent of the total turnover. This does not, of course, include several thousand who received routine group tests, literacy instruction, or informal consultations, in accordance with paragraphs 3, 4, and 5 of our directive. The range of problems runs the entire gamut of human frailty. In this particular case load, inaptitude easily leads the list of problems presented, but that is not necessarily typical of all training centers. The breakdown of this case load is as follows:

TABLE 1

DISPOSITION OF CASES

| | | |
|---|---|---|
| 1. Discharge recommended* | | 336 |
| (a) under Sec. VIII (¾ for "inaptitude") | 293 | |
| (b) referred for psychiatric observation for CDD | 40 | |
| (c) miscellaneous | 3 | |
| 2. Counselling and further observation | | 202 |
| 3. Reassignment or transfer | | 106 |
| 4. (Examination & Report on hospital patients) | | 45 |
| 5. Referred for physical examination & disposition | | 43 |
| Total | | 732 |

* Discharge is effected in approximately 9 out of 10 cases in accordance with recommendation.

As can be seen from the above table, guidance and rehabilitation run a close second to discharge of the mentally unfit, among the psychologist's clinical functions, and in some places may far outweigh the former in the case load. These cases frequently come to the psychologist's attention because they are guardhouse prisoners, "gold-bricks," hypochondriacs, chronic trouble-makers or because they have otherwise run afoul of military discipline. They may be borderline mental defectives, sufferers from minor physical disabilities, or mild alcoholics. They may also be perfectly well-disciplined normal men who are having difficulty adjusting to their current assignments and require reclassification or transfer for the sake of their morale and maximum usefulness to the service. Both by counselling and reassignment, numerous maladjustments may be mitigated or corrected. As a member of the classification officer's staff the Personnel Consultant is in an advantageous position to recommend and follow-up such reassignments. The solutions depend not only on the soldier's qualifications and deficiencies but on local factors of supply and demand, movement orders and requisitions, allotments and tables of organization, the "chain of command," changes in War Dept. directives and policies, etc. Sometimes a little psychological insight or administrative manipulation will solve a troublesome problem. The solutions are sometimes decisive and dramatic, at other times intangible or doubtful. However, every effort is made to conserve manpower and promote morale, and discharge is considered only a last resort for serious cases of maladjustment.

### Educational

1. *Illiterates.* Literacy has generally been regarded as a desirable prerequisite to military training. It has been estimated that approximately 250,000 illiterates have been or will be inducted. To salvage this manpower, Special Training Units have been set up for the instruction of the illiterate, non-English, and otherwise handicapped. Recently such STU's have been gradually removed from training centers and established in reception centers, so that the former would not be burdened with the task of teaching illiterates in the midst of a military training program. To the extent that they have STU's, therefore, reception centers may be considered as training centers. In either case, the Personnel Consultant's function of educational psychologist and classification officer comes into play. His principal duties in this educational program include:

(a) making recommendation regarding grade placement by tests;
(b) selection and instruction of teachers;
(c) supervision of the academic program and achievement tests;
(d) examination and disposition of failures;
(e) classification and assignment of graduates.

Thus the Personnel Consultant contributes to the salvaging of considerable man-power.

2. *Specialist training.* The training of specialists is carried on in all Army training centers and in a selected number of colleges under the Army Specialized Training Program. The Personnel Consultant's function here is merely selective. In a previous assignment, the writer set up the test-score, educational, and physical criteria for twenty-odd specialist schools in a Signal Corps training center. At the one discussed here, he served as a member of the ASTP Selection Board, which passes on the qualifications of candidates for recommendation for college training under that program. A knowledge of educational psychology and academic experience, is, therefore, useful in implementing the Army's program for higher education and specialization. The writer has found the selection of men for ASTP training gratifying in many ways. One is treated to the spectacle of intelligent young Americans being selected for college training on the basis of aptitude and ability without regard to financial ability. Although the immediate purpose is military victory, social usefulness is clear. Languages, for example, are not being studied to produce literary dilettantes but to facilitate international intercourse. Engineers and doctors will obviously not only serve to assure victory of the democracies but will contribute to the country's assets in peace.

3. *Lectures.* The lectures referred to in Par. 7 of our directive, serve a dual purpose: they educate officers in the principles of the military classification system as well as of their psychological responsibilities to their men, and they facilitate the Personnel Consultant's functions. Among other things, the writer gave a two-hour weekly lecture to each new group of officers assigned to that center. Although the educational effect of a two-hour lecture is limited at best, even an elementary understanding of individual differences is a revelation to officers not accustomed or trained to think in such terms. Sporadic attempts have been made here and elsewhere by psychiatrists and psychologists to give orientation lectures to enlisted men to promote morale and motivation. Wherever tried consistently, the results have proven quite beneficial. It is hoped that this practice will become more widespread.

## Summary

Insofar as the writer's experience is typical, the principal duties of the military psychologist (Personnel Consultant) in an Army training center are clinical and educational in nature. The former function is directed toward the elimination of mental misfits as well as guidance and rehabilitation in the innumerable cases of simple maladjustment which arise. These duties are facilitated by close collaboration with psychiatrists and classification officers. A typical case load of over 700 cases examined in 9 months is analyzed. "Inaptitude" is found to be the

greatest single problem, with others ranging all the way from simple misassignment to serious mental deviation. The educational functions include advising on setting up classes for illiterates and on selecting men for specialist training, as well as lecturing officers on personnel psychology. Although academic competence is presupposed, adaptability to military requirements is the primary qualification for the psychologist in the field.

# THE WORK OF PSYCHOLOGISTS IN THE NINTH SERVICE COMMAND SPECIAL TRAINING CENTER*

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AND
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The Special Training Center for teaching illiterates in the Ninth Service Command, which includes the states of Washington, Oregon, California, Idaho, Montana, Utah, Nevada and Arizona, is located at Camp McQuaide, California. Trainees are shipped to this center from the Reception Centers at Fort Lewis, Washington, Presidio of Monterey, California, Fort MacArthur, California, and Fort Douglas, Utah, and are given instruction in academic and military subjects.

The function of a Special Training Unit is the instruction of enlisted men who are not immediately suited to assimilate successfully the regular basic program of training or who during their regular course of instruction indicate that they require special attention. This unit is responsible for teaching illiterates, non-English speaking, and slow learning men.

The specific objectives of this Special Training Center are as follows:

1. To prepare trainees to absorb basic military training at a Replacement Training Center, Unit Training Center or a separate unit.
2. To insure that all men assigned to units are able to read at a fourth grade level.
3. To insure that all trainees are able to understand and to speak simple English.
4. To enable the trainees to do simple problems in arithmetic.
5. To give the trainee sufficient basic military training so that when he is assigned to regular training, he will be able to complete it with a minimum of special assistance.

## Selection and Training Program

Men received at Reception Centers from induction stations in the Ninth Service Command are given the Army General Classification Test and those classified as Group V are reviewed by the classification officers and all non-English speaking men, illiterates, and slow learners, are shipped to Camp McQuaide. The men are tested and then assigned to classes on the basis of their scores. They are grouped in classes according to their abilities and instruction is given in reading, arithmetic and expression. Except in unusual cases the maximum amount of time

* The opinions and assertions contained in this paper are those of the authors and are not to be construed as official or as reflecting the views of the Army.

that a man can remain in the Training Center is twelve weeks, but the course is planned with the idea that the majority of the men will complete it in eight weeks. Men who complete their training program successfully are graduated and shipped to a Reception Center for assignment. Those who are unable to complete the training in the maximum time are discharged. A recommendation for discharge is instigated only after every effort has been made to rehabilitate the man.

### Work of the Psychologist

*Personnel.* Four Personnel Consultants, all of whom have had training and experience in clinical psychology, have been assigned as officers in the Special Training Center. The officers are assisted by eight enlisted men who have had training and experience in testing, interviewing, and the interpretation of statistical data. The Personnel Consultants have been given five types of duties: (1) the testing program, (2) interviewing, (3) personnel records, (4) improving the instructional program, and (5) the collection of statistical data.

*Group Testing.* The initial responsibility of the Personnel Consultants is to determine the capacity of the men assigned for training so that they may be placed in academic classes according to their abilities. This is accomplished by administering two group tests. The first of these consists of three parts,—word meaning, paragraph meaning, and arithmetic, and requires a fair degree of reading skill. The second is made up of illustrated material and requires very little reading ability. On the basis of the scores on these tests the men are assigned to Groups I, II, III, or IV in academic classes. The men are also given a military vocabulary test consisting of 102 terms used frequently in basic military training. This test is given again at the completion of training to determine how many words have been learned. A diagnostic arithmetic test, which includes many combinations of simple addition, subtraction, multiplication, and division, is also given at the beginning and at the completion of training.

Promotion from one level to the next is determined by means of four group tests containing material similar to that included in the test used for initial placement. Graduation from the Training Center takes place when a man has passed the final tests for Group IV (literacy and arithmetic), has been given the Army General Classification Test, and has demonstrated military attainments which justify forwarding him from such a unit. He is then shipped to one of the Reception Centers for assignment. All the group tests used in this program are issued by the Adjutant General's Office with the exception of the diagnostic arithmetic test and the military vocabulary test.

*Individual Testing.* In addition to the group tests every trainee is given a number of individual tests. These tests require approximately

one hour for each man and are given in small interviewing rooms. Most of the examiners speak more than one language which enables them to work more effectively with the non-English speaking men. The trainees spend approximately ten minutes with each of the six examiners. Each examiner is trained to give the whole battery of tests so that it is possible to rotate the tests to avoid the monotony of giving the same test over and over again. The examiner records his findings upon a permanent record card which the interviewee carries from one interviewer to the next.

The individual tests administered to the men include the vocabulary test of the Stanford-Binet Intelligence Examination; the Wechsler Mental Ability Scale B; the Gray Oral Reading Test; a reduced form of the Bell Adjustment Inventory, and an Army Adjustment Inventory. At this station a general information test developed by the authors and measures of paranoia and hypochondria, developed by the second author of this paper, also have been used. All the verbal tests are given orally. Spanish translations have been made of most of the tests and are used with many of the non-English speaking men. Additional individual tests are in the process of development at the present time.

*Interviewing.* The initial interview of a trainee occurs at the same time that he is given the individual mental examination and is an integral part of it. At this interview facts concerning the man's place of birth, occupation, education, income, nationality, criminal record, literacy status, marital status, and family data are obtained. This interview takes place at the head of the line of examiners and requires approximately ten minutes per man. A second type of interview occurs when a man is referred to the Personnel Consultants by the company commanders in connection with a possible discharge for inaptitude. At this time the man's academic and military record is reviewed and a recommendation made to the officer referring the trainee. Classroom instructors frequently refer men to the Personnel Consultants who evidence some personal or social maladjustment in the classroom. Following the interview an oral and a written report are made to the teacher. Requests for interviews of trainees come also from the post surgeon, who is a psychiatrist, and from the other medical officers; these interviews are followed by joint consultations with the referring officers.

*Reporting Personnel Data.* The results of the interviews and testing are recorded on a cumulative record card and then made available to the various sections of the Special Training Center. Every instructor in the school is given a statistical and graphical report on each man in his class. This report is a condensation of the data on the man's cumulative record card. The traits included in the report are general learning ability, skill in oral reading, skill in addition, subtraction, multiplication and division, arithmetic reasoning, emotional stability and morale.

The teacher's attention is called to cases of word-blindness, error patterns in arithmetic, and to cases of emotional instability. The literacy status of foreign speaking individuals is also indicated. These reports are taken personally to the instructors by one of the Personnel Consultants who goes over each trainee's record and calls the attention of the instructor to personal data about the man that may be useful to him in his instruction.

A report of the psychometric examination is also sent to each company commander in the Special Training Center and is essentially a duplicate of the one received by the academic instructor. The difference lies in the fact that the one sent to the officer sometimes includes a statement that a given man is a potential discharge case or that another man is considerably above the average in ability and might be graduated at an early date. Company commanders are also furnished oral reports on men who are potential discharge cases or who are being considered for early graduation.

Each company commander is furnished a report of the scores on all group tests for the men in his company. This includes the initial placement tests, the tests used for promotion from one group to the next, and the final graduation examinations.

The Personnel Consultants also prepare a certificate on each man who is recommended by the company commanders for discharge for inaptitude. The certificate includes a statement of the date of the man's first assignment to the Special Training Center, his age, marital status, education, occupation, scores on all individual and group tests, a history of his academic progress in the Special Training Center, and a recommendation as to whether the man should be discharged from the Army or retained for further training. No man is discharged until his psychometric history has been thoroughly analyzed. In many instances, a man is interviewed a second or a third time in order to make certain whether it is possible for the Army to use him.

*Improving Instruction.* Another responsibility of the Personnel Consultants is the improvement of academic instruction. This is accomplished in part by providing the teachers with information on each man in his class, and by conferences between the teachers and the Personnel Consultant who acts as a liaison officer between the training and the testing sections. Academic instruction is also facilitated by means of evening classes in teacher-training. Such a program has just been completed which extended over a period of six weeks. The classes were held twice a week for approximately two hours for each meeting. The topics covered in the course included: *The place of the special training unit in the Army, the work of the teacher in the Special Training Unit, the psychology of learning, the psychology of arithmetic, reading and spelling, the techniques of teaching reading, the techniques of teaching arithmetic, the*

*methods of teaching spelling, the use of standardized and classroom tests in the improvement of instruction, mental health factors in the classroom,* and *the evaluation of instruction in the special training classes.* The speakers included instructional specialists from the Los Angeles City Schools, the University of California at Los Angeles, and Claremont Colleges; the Commanding Officer, the Battalion Commander, and the Director of Training of the Special Training Center; and members of the Personnel Consultants Section. The meetings consisted of lectures, demonstrations, discussions, and a final examination. The classes will be resumed in the near future at which time committees will be organized to develop supplementary instructional materials adapted to the different ability levels of the men in the Training Center.

*Statistical Studies.* From time to time the Personnel Consultants carry out statistical studies of the men in the Special Training Center. Requests for such studies are received from the Adjutant General's Department in Washington, D. C., from the Headquarters of Ninth Service Command, Fort Douglas, Utah, and from the Battalion Commander of the Special Training Center. Studies of the reliability and validity of the tests now being used are carried on at intervals, and new norms set up. New tests are being developed for individual testing and will be introduced when their statistical validity has been demonstrated.

## BOOK REVIEWS

POLYAK, S. L. The retina. The anatomy and the histology of the retina in man, ape, and monkey, including the consideration of visual functions, the history of physiological optics, and the histological laboratory technique. Chicago: Univ. Chicago Press, 1941. Pp. x + 608, with 100 plates.

The somewhat lengthy sub-title quoted above gives a vignette of this compendious volume. So broad a consideration ought to attract a very wide circle of readers unless the layman interested in the growth of our knowledge about the eye is dismayed by the minutia of detail, or the specialist is made impatient by the inclusion of so much elementary material. A completely comprehensive treatise, as this attempts to be, runs such dangers. On the other hand, a novice who aspires to specialization in the field could do worse than assimilate its contents.

Chapter I gives a brief description of the vertebrate visual mechanism which the reviewer would recommend for assignment to students in elementary psychology and to others beginning the study of vision, since it is always most satisfying to have such a background from the pen of a physiologist. Part I (Chapters II to VI) covers in detail the methods of investigating the histological structure of the nervous system, and for present purposes, we can pass on to Part II which, though it contributes no new data, brings together a history of the study of the eye. Aside from being interesting, it gives emphasis to an aspect of knowledge that is being more and more disregarded in the sciences, particularly in psychology. While George Sarton and others have done much to dispel the "darkness" of the Middle Ages, there is still too great a tendency to disregard our intellectual forebears—even very recent ones—and look upon current techniques and hypotheses as if they were historically unique and autonomous. To accompany the historical discussion figures 5 to 35 show at a glance how knowledge of the eye has grown from Ḥunain Ibn Isḥāḳ A.D. 860 to Raymon y Cajal A.D. 1923. It is interesting to note that many current textbooks carry diagrams of the retina identical with, or very similar to, the conceptions of Kolliker, 1854, M. Schultze, 1870, and Schwalbe, 1874, (Figs. 27, 28).

Part III takes up an historical account of the study of the retina as distinct from that of the eye as a whole. Since such work implies microscopic examination, there is little of importance to record before the time of Leeuwenhoek (1632 to 1723) although the macroscopic observations of the Greeks had given the retina its name. More recent work is evaluated in some detail in order to further the author's thesis that the structure of the retina has not been sufficiently studied. No one, I think, will take exception to that. The section ends with a statement of eight fundamental criticisms of current theory of visual function, of which the one just mentioned is basic and some of which are of particular interest to psychologists. The author raises pertinent objections to certain aspects of the "Duplicity Theory," which imply two distinct retinal processes for "bright white" of photopic vision and "dim white" of scotopic vision, and holds that complete histological separation of the rod system from the cone system is doubtful. Likewise he points out that the known structures are insufficient to explain visual acuity.

The author is now ready to undertake in Part IV his major problem, a study of the "Minute Structure of the Retina," in which he follows his historical mode of presentation. Sixty some plates of original microphotographs, freehand drawings and schematic diagrams with descriptive legends constitute his presentation of data, and make a notable contribution. In interpreting the plates in the text, he places new emphasis upon morphological characteristics of the several neural elements, on the hypothesis that a relationship may be found between structure and function. This, after all, is but an extension of the differentiation between rods and cones to include such things as the termination of the rods in smooth, oval buttons, much different in size and shape from those of the cones which he describes as "quadrangular buds with rounded edges" "a kidney or a pear," "club like or hoofshaped," "more or less conical" according to the region of the retina in which they occur. He gives similar attention to the morphology of the "horizontal or outer associational cells," of the amacrine cells, of the ganglion cells, and of the centrifugal fibers. The way in which he utilizes the morphological data can be illustrated best by quoting directly from his discussion.

That the spreading of a nervous "impulse" is a process requiring a measurable time is well assured from numerous experiences in neurophysiology. This, in turn, implies certain differences in the dynamical status of the diverse parts of a neuron: its cytoplasmic cone, its cortical zone, its surface film, its protoplasmic expansions, its axis cylinder, and its teledendron. For it is impossible to imagine an absolutely homogeneous dynamical condition in all these diverse and often distant parts, arising simultaneously and disappearing like an "explosion." Furthermore, purely structural factors—difference in the shape, size, numbers, arrangement and so forth of the parts of a neuron serving as the synaptical contact surfaces—may be invoked in support of this view (376).

The impressive fact here is the regularity in the arrangement of the synaptical contacts. A neuron of a given variety—for example a mop bipolar or a midget bipolar—is found to possess synaptical organelles of well-defined form, size, location, numbers and so forth, and always arranged in a certain way. The uniform mode of attachment of each variety of these synaptical organelles to certain definite parts of the related neurons—for example the cone pedicles—is striking . . . . The delicate dendritic filaments—for example, of the mop bipolars—are always found adhering to the lateral sides of the cone pedicles and never to their vitreal faces, which, in turn, are reserved exclusively for the contact with the "bouquets" of the midget bipolars, as well as for some other neurons. The conclusion which may legitimately be drawn therefrom is that the lateral face of the cone pedicle has different dynamical potentialities than its vitreal face. This, in turn, suggests that the influences which pass from an apparently common source of impulses, the cone, over to the mop and midget bipolars are not of the same kind but are in some way different from one another (377).

All such considerations are neatly summarized in four schematic diagrams of the nerve elements of the retina and their interconnections. (Figs. 95–98)

Upon this mass of histological data, for whose verifications and acceptance we must look to the specialists in that field, Polyak bases several tentative hypotheses of psychological import. It is unfortunate that he has not brought to those interpretations a similar intimate acquaintance with the psychology of color vision as he has with histology. Perhaps it is too much to expect, but nevertheless its absence precludes satisfactory hypothetization. The assumptions which he lays down at the beginning have their origin in the physics of light and in casual popular psychology, which have as little bearing on the psychological problem as pre Golgi conceptions have on the histological. They are:

The act [sic] of vision is understood to consist of several distinct processes. These processes are: (1) perception of light per se, or the perception of various light intensities, without distinction of the chromatic hues ("light sense"); (2) Perception of color, or the specific reaction of the visual apparatus to different wave lengths of the visible light ("color sense"); (3) Visual space perception, or the appreciation of the position in space of the sources of light stimuli (this comprises every aspect of the dimensional visual functions variously termed as "space sense," "form sense," "localization," "visual acuity," "directional vision," "vision of movement" etc.); (4) integrating visual functions, including phenomena commonly called "higher" or "psychic" visual functions (398).

These set the course of subsequent speculation. The details are too many to be dealt with here, but while no brief sampling can be adequate to the discussion, some of the more striking conclusions may be pointed out. Polyak gives up the notion of different kinds of cones or of photochemical substances in favor of "Chromatic analysis" by the several types of bipolar cells and integration by the midget ganglion cells. He leans strongly to a three component hypothesis with its consequent emphasis upon color mixture to the exclusion of other equally important psychological facts. Color blindness is the only additional phenomenon considered and it is referred, obviously, to some impairment of the bipolar structures.

Finally, a basis for "the visual perception of [two dimensional] space" is sought in the structure of the retina. Polyak departs from Helmholtz's (431) "dictum that 'two bright points cannot be distinguished as separate unless the distance between their images is greater than the diameter of a retinal element" to the extent that "if true, [it] does not seem to be due so much, if at all, to nearness of the photoreceptor elements to one another as to the incomplete separation of their conductor units in the visual pathway." As a basis for the "innate character of the visual space sense" (444, Fig. 100) the author presents evidence for a precise central projection of the binocular cyclopic field of vision. Spatial relationships are retained but cortical representation of the foveal and parafoveal regions is considerably expanded. Just how this central projection solves the problem is not indicated for one can scarcely take seriously the figurative animism suggested.

The treatise concludes with a chapter of statistical data and measurements of the retinal structures, an extensive bibliography of 129 pages and an adequate index.

Although there is no probability that the present volume will ever achieve popularity, one must regret that it has not been more carefully edited by someone for whom English is the mother tongue. There is no evidence that this is a translation, yet choice of words, use of adverbial modifiers, and form of sentence structure are not those of English prose. Many sentences require rereading and even then may not yield clear cut significance. The reviewer is still not sure of the significance of "inner" and "outer" with reference to retinal structures. Finally, the organization of the material gives an impression of much repetition and that conclusion is borne out by the many cross references. This may be partly necessitated by the method of historical treatment but it could have been minimized by more careful organization.

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LANDIS, C. and BOLLES M. Personality and sexuality of the physically handicapped women. New York: Paul B. Hoeber, 1942. Pp. xii +171.

In a previously published study by Landis and others (reviewed in Vol. 38, p. 292–295 of the *Psychological Bulletin*), 153 normal and 142 mentally abnormal

women were interviewed concerning their sex information, experience, and attitudes. Three judges evaluated the personality and sexual adjustment of each woman on a series of scales developed for the purpose. Each subject was given an unusually complete physical examination, including x-rays of the pelvic region No physical differences were found between the normal and abnormal groups, but within the normal groups certain physical measurements of the genitalia and general body form appeared to be related to emotional immaturity and to deviant sexual behavior in adulthood.

The present investigation is a sequel to the earlier study. One hundred physically handicapped women—25 epileptics, 25 cardiacs, 25 spastics, and 25 orthopedic cases—were given the same controlled interview used in the previous study, filled out information blanks regarding background and medical history, and took the Rorschach Ink-Blot Test (the results of the latter are not reported). No physical examinations were given the handicapped women. The subjects were between 17 and 30 years of age, some were married, and all had been handicapped from the age of 13 or earlier. The data obtained from the reports of these women were quantified by the assignment of weights on "evaluation" scales as before, the pooled judgments of three raters determining the weights. Not only were comparisons made with the normal group of the previous investigation, but each handicapped group was compared with the others.

The purposes of the study, as stated by the authors, were:

> to determine (1) the common patterns of psychosexual development and personality adjustment; (2) the psychological differences within the handicapped group that might be associated with such factors as type of home background, age at onset of handicap, and nature of handicap; and (3) the differences between the psychosexual development of the physically handicapped group and the physically normal group from the previous study.

Neither the normal group nor the handicapped group could be considered representative of the general population. The first was obtained from women's organizations on a volunteer basis (in itself a selective factor), and the second from medical clinics which drew mainly lower-middle class patients. Obviously no normative data were available for tracing common patterns of development if by "common" the authors mean typical patterns. Though some information was obtained from comparisons between subgroups with different handicaps, the numbers were too small for adequate statistical treatment. Lack of control of the degree of handicap and the length of hospitalization or institutionalization (14 of the epileptics, for example, were institutional cases at the time of the study) further limits the value of the comparisons made. Information regarding the family background of the subjects was obtained only from the subjects themselves, making the validity of this part of the study questionable.

However, such differences as did appear between the various groups, regardless of the objective accuracy of the facts reported, are in themselves of scientific interest. In view of our almost complete ignorance of the psychosexual development of the physically handicapped woman, and keeping in mind the difficulties of obtaining subjects meeting even the more obvious requirements of age and diagnosis, this study is a valuable pioneer effort. The interviewing seems to have been very carefully done, the evaluation scales well worked out, and the tables of comparisons have been published in full so that all interpretations may be checked by the reader. An investigation such as this in which case history material has been meticulously handled and conclusions have been cautiously drawn, points the way to more frequent use of such data for scientific study, particularly in areas where more objective means are rarely available.

To me the most interesting interpretation concerns the lack of evidence of conflict, undue repression, or over-compensation in the handicapped group. Rather than the frustration which might be expected to result from restricted opportunities for social contacts and normal sex life, there appears to be incomplete development of the sex drive, both with regard to its intensity and to the specificity of its expression. On the basis of Freudian principles, one would anticipate distortion of the total personality; however, there appears to be a simpler explanation of the remarkably good adjustment of most of the handicapped subjects. Lack of social stimulation on the one hand and the overprotection accorded handicapped individuals on the other, seems to have resulted in general emotional immaturity with hyposexuality as a part of the total personality pattern.

KATHARINE M. MAURER.

*University of Minnesota.*

SACHS, HANNS. The creative unconscious—Studies in the psychoanalysis of art. Cambridge, Mass.: Sci.-Art Publishers, 1942. Pp. 240.

A beacon ray for approaching Sachs' treatment of these difficult problems in the field of aesthetics is his simple analogy "that the infantile fantasy-life . . . exercises the same influence on the search for truth as it does on the artist's quest for beauty" (7). Thus we may look to unconscious sources for the basic drives and motive power in creativeness, and also for something of the raw materials or content which are to be worked upon and fashioned into artistic form. The scientist's ambition and interests will be related to his developmental problems, (compulsions, voyeurism, paranoid and narcissistic trends, etc.), as well as his general reactive patterns; these factors will set the initial methodological approaches and select the very areas and problems for study. Yet his finished scientific offering must meet with the laws of logic and scientific method. So, also, the truly perfect work of art has its own criteria for good form or beauty of structure, its own "formal laws," which are universal, in contrast to the more variable psychodynamics in the earlier stages of the creative process. These laws of beauty are Superego standards which, like the formal laws of logic, are considered to have a certain more direct relationship to the structure of objective reality, although the comprehension of these "higher" laws of nature may come through variable developmental routes.

The analogy becomes top-heavy, and Sachs does not overburden it. He grants that very little can be said now of the formal laws of beauty, their nature or their precise relationship to "emotional reality" (one of Sachs' ambiguous concepts). The reviewer has found Gestaltists much more helpful in at least the description of some of the less complex aesthetic problems of formal structure, with their concepts of isomorphism, unity of field structure and the application of the Pragnanz principle. The explanation of the creator's search and his discovery of the formal principles is attendant upon psychoanalytic advance in the theory of sublimation. Sachs has begun here with a stimulating analysis of the role of narcissism as motive for seeking universal standards.

This treatise deals more effectively with certain earlier stages of the creative process: the anxious awareness of the incompletely repressed "dream stuff," the socializing of the unconscious material for communication to others, thus sharing the guilt (since others can then participate in the forbidden fantasies) and the use of techniques for depersonalizing the Id content. These "secondary processes" of the Ego are rather overemphasized, to the neglect of a preliminary creative stage, the Primary process; the essential structuring that occurs at

this first level is practically ignored, except for a belated back-hand reference (189). Sachs fails to utilize Freud's extensive analyses of the primitive processes: condensation, displacement, allusion, symbolisms, etc.

The academician will complain of an obvious lack of continuity in the theoretical structure of the book and also of a disappointing unevenness in the depth of insightful analysis for the many issues and phenomena discussed. These are real faults, and perhaps are not entirely attributable to the complexity of the field. However, there is an exciting and satisfying richness in the illuminating applications of what has begun to be understood in several diverse fields of social phenomena. One example is an analysis of Shakespeare's "Measure for Measure" as a comedy just barely saved from becoming an unbearable tragedy through the special handling of the unconscious fantasy material. A challenging sociological chapter suggests that the invention and spread of manlike machinery may have been dependent upon the growth of a more secure "world conception" as a measure against an anxious, narcissistic inhibition of external representations of human animation. Another section carries the problem of animistic release to the realm of movie cartoons. Also a chapter relates several of Freud's writings to the working out of certain of his infantile wish-patterns. No non-psychoanalytical theory of creativeness has shown this wealth of revelance. The theory here is far from completion and further from experimental verification. And Sachs' presentation lacks the quiet deft precision of Freud's writing on these problems. However, it is unquestionably a significant contribution to our current psychological thinking in the field of aesthetics.

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## BOOKS AND MATERIALS RECEIVED

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## NOTES AND NEWS

JAMES MCKEEN CATTELL, one of the pioneers of modern psychology and one of the distinguished men of our time, died January 20, in Lancaster, Pennsylvania, at the age of 83 years. Dr. Cattell was one of the founders of the American Psychological Association, its Secretary in 1894, and its President in 1895. He was President of the Ninth International Congress of Psychology in 1929. He was a member of the National Academy of Science. In 1888, he became professor of psychology at the University of Pennsylvania, and three years later professor of psychology at Columbia University, a position he held until 1917. From 1917 onward he devoted himself to the editing and publishing of scientific journals. He was editor of *Science* from 1894 until his death; of the *American Naturalist* from 1907–1941; of the *Popular Science Monthly* from 1900 to 1915, and its successor, the *Scientific Monthly* from 1915 to 1941. In 1904 he founded the *Journal of Philosophy, Psychology and Scientific Method*, and in 1915, *School and Society*, which he edited until 1939. He also founded and published the directories, *American Men of Science*, and *Leaders in Education*. In 1924, he was President of the American Association for the Advancement of Science.

MOSHE E. BRILL of the Hebrew University (Jerusalem) died on December 4, 1943. Dr. Brill was elected an Associate of the APA in 1936, and was our only representative in Palestine.

With deep sorrow the psychology department of Connecticut College announces the death on January 6 of DR. MORITZ LÖWI. Formerly director of the psychological laboratory and professor at the University of Breslau, Dr. Löwi came to the United States five years ago. He spent two years as research associate at Connecticut College, where he conducted experiments on the psychology of thinking. During the current year, he was continuing his research at the Norwich State Hospital.

JAMES ROWLAND ANGELL, president emeritus, Yale University, has been appointed director of the Hall of Fame for Great Americans on the campus of New York University.

PAUL C. YOUNG, acting head of the department of psychology, Louisiana State University, has been appointed chairman of the organizing committee of the Louisiana Legislative Council, "an association being formed to promote interest in social progress among state and regional organizations."

WAYLAND F. VAUGHAN of Boston University spoke on "Psychology: The Hope of the Future," on Station WGY's Science Forum program November 24, 1943. His discussion was recorded and will be rebroadcast over 269 local stations as a feature of "Excursions in Science."

The University of Kentucky announces a new program in the field of psychology, predicated on the belief that there will be an unprecedented demand for men and women trained in industrial psychology after the war. Because of the return of millions of persons to civilian pursuits, the problem of training in personnel relations becomes of major significance. The program designed for

juniors and seniors involves: (a) related courses in different departments of the university as background material, (b) the development of the essential skills and techniques in the psychological laboratories, and (c) actual tryout and practice with cooperating firms and public agencies. HENRY BEAUMONT is the originator of the course.

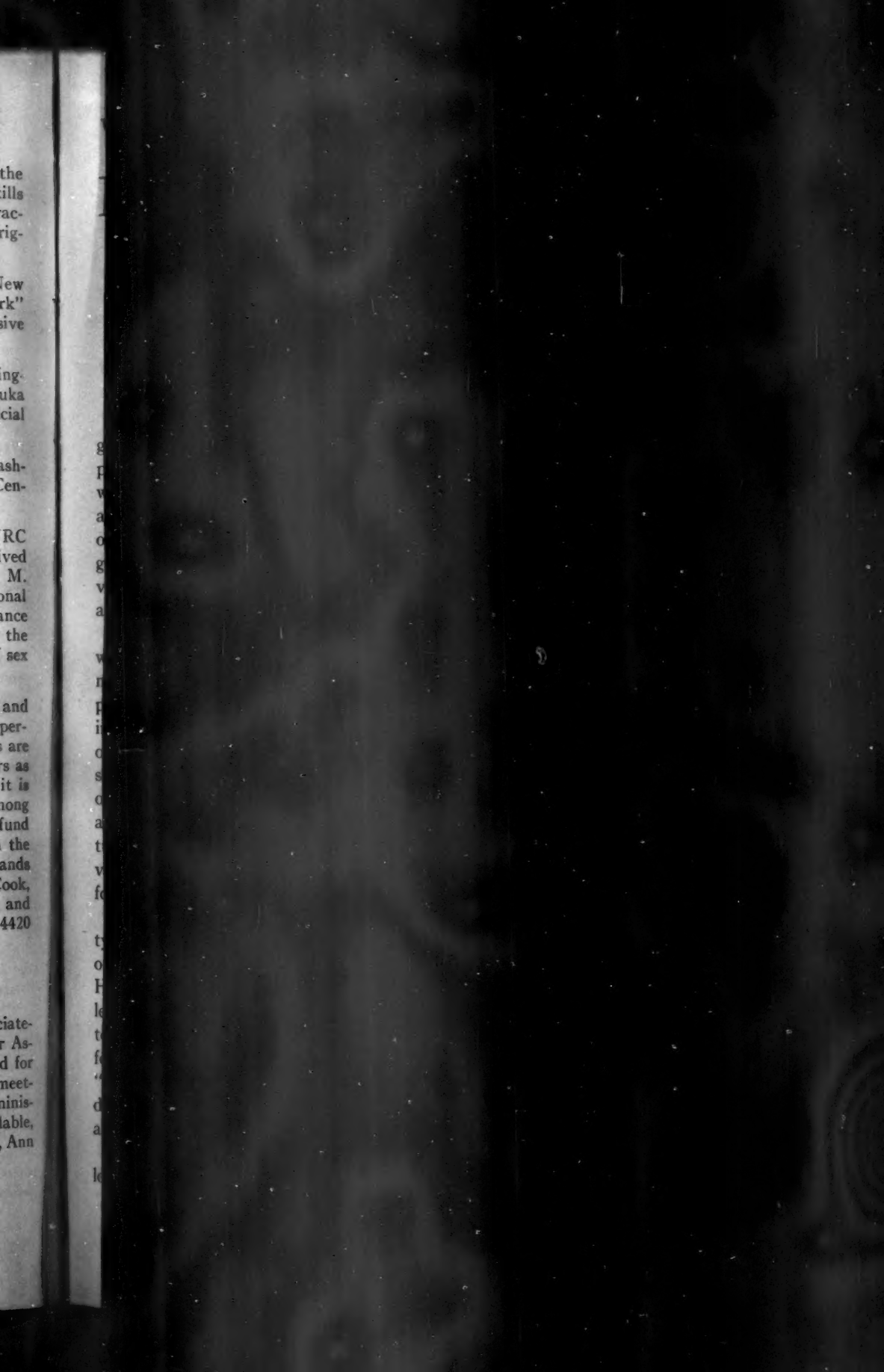
HAROLD SAXE TUTTLE, of the department of education, City College (New York), has been granted a year's leave of absence to write a "pioneer work" in which he "will seek to apply the principle of conditioning to a comprehensive program of education for citizenship."

RICHARD H. EDWARDS, visiting professor at Howard University (Washington, D. C.), has been appointed visiting professor at Keuka College (Keuka Park, N. Y ) for the second semester beginning February 1 to "conduct special courses of integration in the department of psychology."

CHARLOTTE A. WRIGHT, former assistant dean, Ward-Belmont School (Nashville, Tenn.) has been appointed professor of psychology and religion, Centenary Junior College, Hackettstown, N. J.

Applications to the Committee for Research in Problems of Sex of the NRC for financial aid during the fiscal year beginning July 1 should be received before April 1. They may be addressed to the chairman, DR. ROBERT M. YERKES, Yale School of Medicine, New Haven 11, Conn. Although hormonal investigations continue to command the committee's interest, in accordance with current policy, preference will ordinarily be given to proposals for the investigation of neurological, psychobiological and behavioral problems of sex and reproduction.

*Barbara Burks Memorial Fund.* In the wish to express their appreciation and regard for Barbara Stoddard Burks, whose death has meant a great loss, personal and professional, to many psychologists and geneticists, her friends are establishing a memorial fund. Because of her activities during five years as chairman of the APA Committee on Displaced Foreign Psychologists, it is proposed to use the fund to promote international professional relations among workers in the fields of psychology and genetics—for example, as a loan fund for assistance to European scholars studying or carrying on research in the United States. For the present, administration of the fund will be in the hands of a committee composed of Gordon Allport, Katherine Brehme, Robert Cook, Kurt Lewin, Theodore Newcomb, Lewis M. Terman, Ruth S. Tolman, and Robert S. Woodworth. Contributions may be sent to RUTH S. TOLMAN, 4420 Fiftieth Street, N.W., Washington, (16), D. C.

## NOTICE

March 15th is the deadline for the application for transfer from Associateship to Membership in the APA. The deadline for new applications for Associateship is July 15th. Applications for transfer as of March 15th, and for Associateship as of July 15th, will be considered at the September, 1944, meeting of the Association. Usually blanks may be secured from the nearest administrative or departmental office in psychology. In case they are not available, write directly to the *Secretary*, WILLARD C. OLSON, University of Michigan, Ann Arbor, Mich.